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SELECTED WATER RESOURCES ABSTRACTS

A monthly publication of the Geological Survey
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The Secretary of the Interior has determined that the publication of the periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Office of Management and Budget through September 30, 1986.

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.

PREFACE

Selected Water Resources Abstracts, a monthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. These documents cover water resources as treated in the life, physical, and social sciences and the related engineering and legal aspects of the characteristics, supply condition, conservation, control, use, or management of water resources. Each abstract includes a full bibliographic citation and a set of descriptors which are listed in the **Water Resources Thesaurus.** The abstract entries are classified into 10 fields and 60 groups similar to the water resources research categories established by the Committee on Water Resources Research of the then Federal Council for Science and Technology.

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THE WATER RESOURCES SCIENTIFIC INFORMATION CENTER DOES NOT PROVIDE COPIES OF DOCUMENTS ABSTRACTED IN THIS JOURNAL. Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
U.S. Geological Survey
MS 425 National Center
Reston, VA 22092

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02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Nonwater Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

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SELECTED WATER RESOURCES ABSTRACTS

1. NATURE OF WATER

1B. Aqueous Solutions and Suspensions

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICO-CHEMICAL DATA AND MICROSCOPICAL OBSERVATIONS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2K.
W86-04125

2. WATER CYCLE

2A. General

PRELIMINARY ESTIMATION OF NATURAL RUNOFF IN THE HUAI HE BASIN,
Academia Sinica, Beijing (China). Inst. of Geography.
T. Qicheng, C. Tianwen, and L. Lukai.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 245-255, 3 fig, 3 tab, 5 ref.

Descriptors: *Water transfer, *Diversion, *Water supply, *Water use, *Runoff, *China, Annual runoff, Runoff volume, Canals, Water supply development.

As part of the evaluation of the proposed south-north water transfer project in eastern China, the runoff in the Huai He Basin was estimated. The general characteristics of the basin, the average annual precipitation, and the average annual evapotranspiration, are provided as background information, and as part of the calculations. The average annual volume of natural runoff was calculated to be 35.08 cu km. (Halterman - PTT)
W86-03935

ATMOSPHERIC MOISTURE BALANCE IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
S. Jianzhu, W. Yonglian, Z. Changduo, and Q. Geng.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 333-350, 9 fig, 3 tab, 9 ref.

Descriptors: *Water transfer, *Water supply, *Meteorology, *Precipitation, *China, Water supply development, Diversion, Canals, Irrigation, Environmental effects, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, meteorological data from May and July, 1969-1973, were used to make some rough estimates of atmospheric water vapour content and transport, the moisture cycle and the possible change in precipitation in the region which would be affected. There are large year-to-year variations in depth in precipitable water and water vapour transport value. On the average, 11 to 25 percent of precipitation is formed by water vapour from local evaporation. There is year-to-year variation in the effect of the endogenous cycle which causes a higher percentage of total precipitation in a dry year than in a wet year. The average increase in precipitation during May would be about 3 percent. (Halterman - PTT)
W86-03942

CONSIDERATIONS FOR DEVELOPMENT OF A BASIN MODEL FOR BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
M. S. K. Chowdhury, and A. Nishat.
IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 62-68, 1 fig, 9 ref.

Descriptors: *Planning, *Hydrologic models, *River basins, *Model studies, *Bangladesh, Water management, Water resources development, Mathematical models, Political constraints.

Requirements for a mathematical model to use in planning a river basin model for Bangladesh are presented. Conditions peculiar to this region are the three river systems (Ganges, Brahmaputra, and Meghna), extreme flatness of the landscape, uneven rainfall distribution, and political problems. (Cassar - PTT)
W86-03961

CONTRIBUTION OF ISOTOPE TECHNIQUES IN THE DETERMINATION OF THE RELATIONSHIP SURFACE WATER/GROUNDWATER IN BANGLADESH (GANGES AND BRAHMAPUTRA AREAS),
International Atomic Energy Agency, Vienna (Austria).
M. Dray.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 158-170, 7 fig.

Descriptors: *Surface-groundwater relationships, *Recharge, *Groundwater movement, *Geochemistry, *Isotope studies, *River basins, Ganges River, Brahmaputra River, Bangladesh, Tritium, Water level, Radioisotopes.

Isotopes studies of the rivers of Bangladesh (Ganges and Brahmaputra) showed that the Ganges does not have rapid interaction with groundwater with respect to the water transfer, as shown by very different chemistry and isotope contents. Nevertheless, the Ganges has an important role in minimizing water table fluctuation by ensuring the base level. During flooding the Ganges groundwater recharge exists by is very slow. The Karatoya-Atrai River in the north behaves similarly to the Ganges. However, the Brahmaputra system surface water and groundwater are remarkably similar. This difference in behavior as compared with the Ganges is related to different particle size and permeability of alluvial deposits, which are probably coarser in the Brahmaputra River bed. Here tritium is found in wells of 250-ft depth, whereas in the Ganges area wells of 100-ft depth are tritium free. (Cassar-PTT)
W86-03969

GROUND-WATER MODELS, VOLUME I: CONCEPTS, PROBLEMS, AND METHODS OF ANALYSIS WITH EXAMPLES OF THEIR APPLICATION.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 2F.
W86-03974

APPLICABILITY OF MODELS TO ALLUVIAL VALLEYS: ARKANSAS RIVER VALLEY, COLORADO, U.S.A.,
Geological Survey, Reston, VA.
L. F. Konikow, and J. D. Bredehoeft.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 27-37, 6 fig, 2 tab, 12 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, *Rivers, Arkansas River, Colorado, Alluvial rivers, Irrigation effects.

The complex hydrologic and water quality variations that exist in an irrigated alluvial stream-aquifer system can be simulated with a digital simulation model that couples a finite-difference technique, used to solve the flow equation with the method of characteristics, used to solve the solute-transport equation. This modeling technique was successfully applied to an 18-km reach of the Arkansas River valley in southeastern Colorado for a 1-year period. The simulation results greatly aided the understanding of hydrologic and water quality variations within this area and their relations to irrigation practices. Changes in the dissolved solid concentration of groundwater were predominantly controlled by convective transport and by mixing with recharged water of different quality. In this simulation the influence of hydrodynamic dispersion was relatively minor. Once calibrated, the model can be used to predict future trends and the effects of changes in water management practices on the quality and quantity of ground and surface water. Analysis of the predictive tests for the study area indicated that initial or short-term responses to changes in irrigation practices are strongly related to antecedent conditions, and do not necessarily reflect actual long-term responses to these changes. (Author's abstract)
W86-03975

MODEL ANALYSIS OF GROUND WATER IN THE SAN LUIS VALLEY, COLORADO, U.S.A.,
Geological Survey, Louisville, KY.
P. A. Emergy.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with examples of their Application, The UNESCO Press: Paris, France, 1982. p 53-66, 9 fig, 8 ref.

Descriptors: *Hydrologic models, *Groundwater, *Rivers, *Model studies, San Luis Valley, Rio Grande River, Conejos River, Colorado, Water loss.

A three-layer analog model of the San Luis Valley, Colorado, was used to simulate the groundwater reservoir of the Rio Grande and Conejos River. Several conclusions were developed. (1) The source of more than one-half the water withdrawn from the confined aquifer by large-capacity wells in 1950-1970 was water in storage and evapotranspiration salvage in the unconfined aquifer. (2) During this time withdrawal by large-capacity wells in the confined aquifer depleted the total flow of the Conejos River by 270 million cu m. If more groundwater and less surface water were used, additional water could be salvaged from evapotranspiration. For example, doubling the 1970 rate of withdrawal by large-capacity wells in the confined aquifer would result in the salvaging from evapotranspiration of an additional 185 million cu m of water during the first 10 years. If withdrawal rates were held constant, a new equilibrium would eventually be established and all withdrawn would be derived from salvaged evapotranspiration and streamflow. (Cassar - PTT)
W86-03977

AQUIFER OF ULLUM-ZONDA VALLEY (ARGENTINA),
United Nations, New York.
For primary bibliographic entry see Field 2F.
W86-03978

ASSESSMENT OF EXPLOITABLE GROUNDWATER RESOURCES OF THE SOKH DEBRIS CONES,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-03980

ASSESSMENT OF EXPLOITABLE GROUNDWATER RESOURCES IN FISSURED-KARSTIC FORMATIONS IN THE SERGA RIVER VALLEY (SERGINSKOE AQUIFER, URAL),
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
L. S. Yazvin, and I. I. Krashin.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 137-142, 3 fig, 1 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, Serga River, USSR, Serginskoe aquifer, Karst, Surface-groundwater relations, Aquifers, Wells, Recharge.

Groundwater resources were studied in karstic formations of the Serga River Valley, USSR. The Serginskoe aquifer, on the western slope of the Ural Mountains, supplied a highly developed industrial area with a dense population. Although the Serga River is polluted and unsuitable for drinking water, it serves as recharge to the aquifer. Model predictions showed optimum well locations and pumping rates. Calculations showed that during the January-February period of low water, discharge of Groundwater from both aquifers to the Serginskoe takes place. In March the groundwater discharge is equal to the low water discharge of the river. In the flood period, when part of the valley is filled with water, a sharp increase of infiltration to the aquifer from the Serga River takes place. This water recharges the alluvium. At the end of the flood period infiltration from the river decreases and a portion of the storage in the alluvium is discharged. Later this discharge ceases, and infiltration from the Serga River is maintained until the end of the period of high waters. (Cassar - PTT)
W86-03986

ESTIMATION OF EXPLOITABLE RESOURCES OF A MULTILAYERED WATER-BEARING SYSTEM IN THE SOUTH-WESTERN PART OF THE DNEPROVO-DONETSKY ARTESIAN BASIN,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
B. V. Borevsky, and I. I. Krashin.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 177-182, 2 fig, 2 ref.

Descriptors: *Hydrologic models, *Model studies, *Groundwater, *Recharge, Groundwater recharge, Kiev, USSR, Aquifers, Dneprovo-Donetsky basin, Artesian basins.

The multilayered aquifers in the Dnieper River basin in the area of Kiev, USSR, were characterized by model studies. The total balance of exploitable groundwater resources was established for the principal aquifers. The main sources replenishing these resources are surface runoff and water from the overlying aquifers. Elastic resources play a more or less important role only during a relatively short period of time after withdrawals are increased. In particular, with a sharp increase of the water intake capacity (5 times as high as the existing capacity), the withdrawal will be provided from elastic resources in the initial period discharge from the Cenomanian-Callovian aquifer complex (20%) and from the middle Jurassic aquifer (80%). However, after 10 years of exploitation, almost all the water withdrawn from the Cenomanian-Callovian aquifer and 70% of the water withdrawn from the Jurassic aquifer are derived from recharge. (Cassar - PTT)
W86-03990

DIAGNOSTIC HYDROLOGY,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
R. J. M. de Wiest.
Ground Water GRWAAP, Vol. 24, No.3, p 332-341, May-June 1986. 10 fig, 2 tab, 12 ref.

Descriptors: *Surface-groundwater relations, *Hydrologic properties, *Diagnostic methods, Pumping, Groundwater movement, Aquifers, Recharge, Basins, Hydrographs, Runoff, North Carolina, Ramona, California.

The paper examines two cases of surface water/groundwater interrelationships, one in Beaufort County, North Carolina and one in Ramona, California. Differential diagnoses are made between alternate solutions rendered by hydrologic methods. In the first case, it is proven that the pumping and subsequent wastage to the ocean of 65 mgd in order to operate the Texas Gulf Sulphur phosphate mine, poses no threat to the environment. In the second case, attempts were made to obtain, by means of the theory of groundwater flow, an estimate of the physiographic volume of the Santa Maria creek groundwater basin in Ramona. The outcome of these calculations have been submitted to test the compatibility with the results of an actual pumping test, and with pumping records made available by the Ramona Municipal Water District. Results show a water storage capacity on the order of 4,600 AF for the entire basin. In order to correlate recharge of the basin directly with the precipitation on the basin, a hydrograph analysis has been done for the 20 largest runoff-producing months of the streamflow records 1965-1982. From this study it follows that the average (annual) recharge to the basin is of the order of 1,340 AF/yr and that the physiographic volume, as derived previously, is amply adequate to absorb this recharge. (Lantz-PTT)
W86-04277

MOMENTS OF CATCHMENT STORM AREA,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
W. Ainliang.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1185-1194, August 1985. 8 fig, 1 tab, 14 ref, NSF Grant No. ATM-8114723, NASA Grant No. NAG 5-388.

Descriptors: *Rainfall-runoff relationships, *Spatial distribution, *Catchment areas, *Models, *Rainstorms, Precipitation, Mathematical models, Mathematical studies, Flood frequency, Storm runoff.

The portion of a catchment covered by a stationary rainstorm is modeled by the common area of two overlapping circles. Given that rain occurs within the catchment and conditioned by fixed storm and catchment sizes, the first two moments of the distribution of the common area are derived from purely geometrical considerations. The variance of the wetted fraction is shown to peak when the catchment size is equal to the size of the predominant storm. The conditioning on storm size is removed by assuming a probability distribution based upon the observed fractal behavior of cloud and rainstorm areas. (Author's abstract)
W86-04316

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 1. THEORY,
Geological Survey, Denver, CO.
B. M. Troutman.
Water Resources Research, Vol. 21, No. 8, p 1195-1213, August 1985. 78 ref.

Descriptors: *Error analysis, *Runoff, *Rainfall-runoff relationships, *Hydrologic models, *Mathematical studies, *Statistical analysis, Statistical methods, Models, Mathematical models, Precipitation, Prediction, Regression analysis, Flood frequency.

Errors in complex conceptual precipitation-runoff models may be analyzed by placing them into a statistical framework. This amounts to treating the errors as random variables and defining the probabilistic structure of the errors. By using such a framework, a large aray of techniques, many of which have been presented in the statistical literature, becomes available to the modeler for quantifying and analyzing the various sources of error. A number of these techniques are reviewed in this paper, with special attention to the peculiarities of hydrologic models. Known methodologies for parameter estimation (calibration) are particularly applicable for obtaining physically meaningful estimates and for explaining how bias in runoff prediction caused by model error and input error may contribute to bias in parameter estimation. (Author's abstract)
W86-04317

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 2. CASE STUDY,
Geological Survey, Denver, CO.
B. M. Troutman.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1214-1222, August 1985. 6 fig, 20 tab, 4 ref.

Descriptors: *Case studies, *Storm runoff, *Models, *Error analysis, *Rainfall-runoff relationships, Sensitivity analysis, Hydrologic models, Model studies, Mathematical models, Mathematical studies, Runoff.

Errors in daily-mode and storm-mode runoff predictions given by the U.S. Geological Survey precipitation-runoff modeling system are examined for a 28-month data set from Blue Creek in Alabama. Several error measures are compared, and in some cases, error measures computed after a logarithmic transformation on runoff predictions may be more representative of model performance. By use of a split sample validation period, various calibration methods are compared. It was shown that maximum-likelihood-based procedures that are derived from the error structure exhibited by model predictions usually yield better parameter estimates. Sensitivity analyses are employed to aid in selecting parameters for calibration and computing estimates of uncertainty in calibration results. Leverage of individual values on calibration results is examined using influence statistics. Residual plots are shown to be very useful in identifying error structure and in interpreting calibrations. It is concluded, that, in general, the various tools presented in the statistical regression literature are valuable in interpreting errors in modeling and in determining appropriate calibration strategies. (Geiger-PTT)
W86-04318

WATER BALANCE OF LAKE VICTORIA,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2H.
W86-04386

OPERATIONAL TESTING OF HYDROLOGICAL SIMULATION MODELS,
National Hydrology Research Inst., Ottawa (Ontario).
For primary bibliographic entry see Field 7C.
W86-04391

VARIABILITY OF PESTICIDE LOADS TO SURFACE WATERS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 5B.
W86-04491

DIURNAL MIXED LAYER,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2H.
W86-04510

PERIODIC AUTOREGRESSIVE-MOVING AVERAGE (PARMA) MODELING WITH APPLICATIONS TO WATER RESOURCES,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2E.
W86-04529

FOURIER INFERENCE: SOME METHODS FOR THE ANALYSIS OF ARRAY AND NON-GAUSSIAN SERIES DATA,
California Univ., Berkeley. Dept. of Statistics.
For primary bibliographic entry see Field 7C.
W86-04530

BAYESIAN MODELS OF FORECASTED TIME SERIES,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 805-814, October 1985. 7 fig, 24 ref. NFS

CEE-8300928.

Descriptors: *Snowmelt, *Runoff, *Forecasting, *Markov processes, *Time series analysis, *Statistical methods, Mathematical models, Runoff forecasting.

Bayesian Processor of forecasts (BPF) combines a prior distribution, which describes the natural uncertainly about the realization of a hydrologic process, with a likelihood function, which describes the uncertainty in categorical forecasts of that process, and outputs a posterior distribution of the process, conditional upon the forecasts. The posterior distribution provides a means of incorporating uncertain forecasts into optimal decision models. In this paper fundamentals of building BPF of time series are presented. They include a general formulation, stochastic independence assumptions and their interpretation computationally tractable models for forecasts of an independent process and a first-order Markov process, and parametric representations for normal-linear processes. An example is shown of an application to the annual time series of seasonal snowmelt runoff volume forecasts. To make rational decisions and to derive the full economic benefit from uncertain forecasts, the decision maker needs a parsimonious description of forecast uncertainty. The concept of BPF offers a framework for obtaining such a description in the form of posterior distributions. (Rochester-PTT)
W86-04532

2B. Precipitation

MODEL ANALYSIS OF GROUND WATER IN THE SAN LUIS VALLEY, COLORADO, U.S.A.,
Geological Survey, Louisville, KY.
For primary bibliographic entry see Field 2A.
W86-03977

CHEMICAL TRANSFORMATIONS IN GROUNDWATER,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
W. R. Mabey, and T. Mill.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 61-64, 3 tab, 17 ref.

Descriptors: *Groundwater pollution, *Chemical transformation, *Chemical analysis, Chemical degradation, Groundwater, Groundwater movement, Transformation.

The presence of chemicals in groundwater is of concern because groundwater is the major source of drinking water for 70% of the US population. Unlike chemicals in surface waters that are effectively removed via natural or treatment processes and are readily sampled to monitor concentrations, chemicals in the unsaturated region and in groundwater will be a source of chemicals for many years because they move slowly and are not accessible for economical short term remedies. Therefore, understanding how fast the chemicals move in groundwater and the transformation reactions that may alleviate or create problems posed by the chemicals is important for future planning of groundwater use. The ability to predict the rates of various transformation processes in groundwater will assist in explaining the persistence or absence of chemicals in these systems, and in guiding future studies as to which properties should be measured and which chemical species (especially products) should be sought in future studies. This paper reviews the chemical transformation processes that may be important for transforming some anthropogenic chemicals in groundwater. (Author's abstract)
W86-04057

CLIMATOLOGICAL VARIABILITY,
Argonne National Lab., IL.
For primary bibliographic entry see Field 5B.
W86-04140

STOCHASTIC MODELING OF THE SPACE-TIME STRUCTURE OF ATMOSPHERIC CHEMICAL DEPOSITION,
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 5B.
W86-04171

KINETICS OF ALUMINUM FLUORIDE COMPLEXATION IN ACIDIC WATERS,
Maine Univ. at Orono. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04226

STOCHASTIC DYNAMICS OF PRECIPITATION: AN EXAMPLE,
Toronto Univ. (Ontario). Dept. of Physics.
H.-R. Cho.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1225-1232, August 1985. 5 fig, 7 ref.

Descriptors: *Precipitation, *Stochastic hydrology, *Cyclonic precipitation, *Rainfall distribution, *Mathematical models, Stochastic process, Air temperature, Mathematical studies, Cyclones, Model studies, Models.

An example is developed to illustrate how atmospheric dynamics may naturally lead to stochastic behavior in precipitation. Due to a process in the atmosphere known as scale contraction, large fluctuations in precipitation may be induced by small mesoscale inhomogeneities in the initial temperature field. During the development of a mid-latitude cyclone, scale contraction occurs naturally over the cyclonic region of the the system. The rate of contraction is determined by the rate of growth of the baroclinic wave. With such a contration imposed at the large scale, it is expected that small mesoscale temperature modifications will be able to induce additional mesoscale ageostrophic features. A three-dimensional numerical model simulating the growth of a baroclinic wave has been used to study this effect. Results of these simulations show that small temperature perturbations of the order of a few Kelvin at the mesoscale can induce, during the growth of a baroclinic wave, strong mesoscale ageostrophic flow which may cause the formation of rainbands. The degree of randomness in precipitation distribution may be considerably amplified if latent heating effect is included in the models. (Geiger-PTT)
W86-04319

GENERALIZED SCALE INVARIANCE IN THE ATMOSPHERE AND FRACTAL MODELS OF RAIN,
Etablissement d'Etudes et de Recherches Meteorologiques, Paris (France).
S. Lovejoy, and D. Schertzer.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1233-1240, August 1985. 11 fig, 1 tab, 43 ref. CNRS No. ATP-RA(84) 16.

Descriptors: *Rain, *Precipitation, *Coriolis force, *Mathematical models, *Model studies, *Stochastic hydrology, Mathematical studies, Probability distribution, Rainfall, Clouds, Simulation analysis, Theoretical analysis.

By developing previous work on scaling and intermittency in the atmosphere, the scope of rain models can be greatly extended. While the atmosphere cannot be self-similar, it does obey a related symmetry principle called generalized scale invariance in which the relationship between small-scale and large-scale structures involves not only magnification but also differential rotation and stratification. On the other hand, the richness of atmospheric structures and the phenomenology of sudden changes (intermittency) require that fluctuations be very strong or hyperbolic in form. These theories were illustrated in the fractal sums of pulses process (FSP) which models the rain field by a hierarchy of simple pulse shapes, and by the scaling cluster of pulses process (SCP) in which the pulse centers are clustered so that the basic element may be regarded as a complex (fractal) pulse. The SCP gave closer agreement with the measured fractal parameters of rain and served as a crude model of mid-latitude cyclones. The FSP process was used to illustrate both the horizontal stratification of rain and the differential rotation associated with the Coriolis force; simulations were visually realistic and could display the perpendicularity of the large- and small-scale structures visible in many real cloud photographs. A numerical procedure was also developed which enabled fractal dimensions to be accurately calculated. The question of multidimensionality was considered along with future developments. (Geiger-PTT))
W86-04320

PARAMETER ESTIMATION FOR A MODEL OF SPACE-TIME RAINFALL,
Interstate Commission on the Potomac River Basin, Rockville, MD.
J. A. Smith, and A. F. Karr.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1251-1257, August 1985. 1 fig, 3 tab, 15 ref, append.

Descriptors: *Model studies, *Rainfall, *Mathematical models, *Spatial distribution, *Temporal distribution, Rainstorms, Models, Mathematical models, Hydrologic models, Rain gages, Networks, Mathematical studies, Numerical analysis, Data collections.

Parameter estimation procedures, based on data from a network of rainfall gages, are developed for a class of space-time rainfall models. The models, which are designed to represent the spatial distribution of daily rainfall, have three components, one that governs the temporal occurrence of storms, a second that distributes rain cells spatially for a given storm, and a third that determines the rainfall pattern within a rain cell. Maximum likelihood and method of moments procedures are developed and limitations on model structure that are imposed by restricting data sources to rain gage networks are illustrated. The estimation procedures are applied to a 240 sq mi catchment in the Potamac River basin. The problems described for circular rain cells of fixed radius will be more acute for models which accomodate additional structure such as elliptical rain cells or cells with varying radii. While both estimation procedures can be implemented, the method of moments procedure requires substantially less computational effort than the maximum likelihood procedure. Numerical results emphasize the role of spatial scale in model development. Topographically induced inhomogeneities should also play a major role in determining the appropriate scale or formulation of space-time rainfall models. (Geiger-PTT)
W86-04321

APPROXIMATIONS OF TEMPORAL RAINFALL FROM A MULTIDIMENSIONAL MODEL,
Universidad Simon Bolivar, Caracas (Venezuela). Graduate Program in Hydrology and Water Resources.
J. B. Valdes, I. Rodriquez-Iturbe, and V. K. Gupta.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1259-1270, August 1985. 7 fig, 4 tab, 13 ref. Army Research Office Grant No. 21078-GS.

Descriptors: *Temporal distribution, *Rainfall, *Models, *Rainfall intensity, *Simulation analysis, Numerical analysis, Mathematical models, Statistical methods, Mathematical studies, Model studies.

The feasibility of representing the temporal structures of a multidimensional rainfall process with simpler stochastic models and a study of the effect of parameter robustness on the time scale is studied by use of controlled numerical experiments. A multidimensional representation for precipitation is used to simulate rainfall in space and time. Two-year traces of rainfall intensities at fixed gage stations were generated at 0.1 hr intervals for three climates. These traces are then aggregated at different time scales ranging from 1 to 24 hr. First and second-order statistics are examined from the series at each aggregation level and are used for estimating the parameters of three one-dimensional models of temporal rainfall at a point: Poisson model with independent marks, rectangular pulses

with independent intensity and duration, and Neyman-Scott with independent marks. The compound Poisson model was able to reproduce the statistical structure of the simulated traces only at very high levels of aggregation. The rectangular pulses model had parameters which varied significantly with the time scale of aggregation and caused large distortions in the mean depth and duration of storm events. The Neyman-Scott model was the most stable model throughout the different time scales, and it also reproduced quite well the average storm characteristics at the event level. None of these three models gave a satisfactory reproduction of the simulated extreme value distribution of the multidimensional model. (Geiger-PTT)
W86-04322

SCALING LIMITS AND SELF-SIMILARITY IN PRECIPITATION FIELDS,
Oregon State Univ., Corvallis. Dept. of Mathematics.
E. Waymire.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1271-1281, August 1985. 1 fig, 51 ref. NSF Grant No. CEE-830864.

Descriptors: *Precipitation, *Hydrologic models, *Model studies, Mathematical studies, Mathematical models, Probabilistic process, Stochastic process.

In the literature on rainfall hydrological models, the exact calculations of probabilities for models incorporating cluster structure are typically not possible. Consequently, limiting approximations are often used that involve some important issues for both theoretical as well as experimental considerations in precipitation research. The present paper systematically describes these issues as they pertain to rainfall models. Some specific large-scale approximations are given for Poisson and compound Poisson models, double stochastic Poisson models, rectangular pulse models, Neyman-Scott models, and space-time models. Two different conceptual approaches for obtaining representations at the coarser scale are also discussed. (Geiger-PTT)
W86-04323

NEW APPROACH FOR INSTANTANEOUS RAIN AREA DELINEATION IN THE MIDLATITUDES USING GOES DATA,
Atmospheric Environment Service, Downsview (Ontario).
A. A. Tsonis, and G. A. Isaac.
Journal of Climate and Applied Meteorology, Vol. 24, No. 11, p 1208-1218, November, 1985. 9 fig, 4 tab, 18 ref.

Descriptors: *Satellite technology, *Rainfall area, *Rainfall distribution *Infrared imagery, *Radar, Cloud physics, Mathematical studies, Models, Prediction, Temperate zone, Remote sensing, Convective precipitation.

A new approach is presented for instantaneous rain area delineation in the midlatitudes using GOES visible and infrared data. In the first part of the method, a technique for the differentiation between raining and nonraining clouds is developed based on the location of peaks in the visible/infrared domain. In the second part, a scheme which delineates the rain area is presented. Use of the approach showed that during daylight, the visible image contains more information about rainfall than does the infrared image in the midlatitudes. However, in some instances, the infrared data are useful in differentiating between raining and nonraining clouds that give similar responses. The scheme was found to be very satisfactory in delineating the instantaneous rain area in convective cases, suggesting that the method could also be used in the tropics. When convective and nonconvective cases are considered, the resulting average probability of detection was about 66% and the false alarm ratio was about 37%. (Geiger-PTT)
W86-04325

RADIOMETRIC OBSERVATIONS OF SUPERCOOLED LIQUID WATER WITHIN A SPLIT FRONT OVER THE SIERRA NEVADA,
Bureau of Reclamation, Auburn, CA. Auburn-Folsom South Unit.
M. F. Heggli, and D. W. Reynolds.
Journal of Climate and Applied Meteorology, Vol. 24, No.11, p 1258-1261, November, 1985. 3 fig, 5 ref.

Descriptors: *Cloud seeding, *Sierra Nevada, *Clouds, *Weather modification, *Artificial precipitation, Radiometry, Precipitation, Ice, Storms, Artificial storms, Models, Model studies, Radar, California, Katafront, Supercooled liquid water, Water supply development.

A storm bearing close structural resemblance to a katafront was observed from the ground with a microwave radiometry and a vertically pointing Ka-band radar over the Sierra Nevada of California to study opportunities for precipitation enhancement. The onset and duration of supercooled liquid water (SLW) was determined and matched to a split front model used to describe the synoptic features of a katafront. Previous studies show a tendency for SLW to be in shallow clouds where low level moisture fields appear to show the greatest potential for cloud seeding. Results indicate that prior to the passage of the upper front no SLW was observed. This portion of the storm provided the deepest clouds and coldest cloud tops. SLW was most prevalent after the upper front passage, and persisted until the suspected surface front passage. The duration of the measured SLW was 16 hr. Future studies will attempt to assess the amount of SLW that constitutes a seedable situation and the seeding strategy to be used to extract this water effectively in order to increase the region's water supply. (Geiger-PTT)
W86-04326

CHARACTERISTICS OF THUNDERSTORMS IN ZARIA, NIGERIA,
Ahmadu Bello Univ., Zaria (Nigeria). Dept. of Geography.
E. O. Oladipo, and M. E. Mornu.
Weather WTHRAL, Vol. 40, No. 10, p 316-322, October 1985. 4 fig, 1 tab, 9.

Descriptors: *Diurnal distributions, *Thunderstorms, *Nigeria, *Afternoon evening thunderstorm regime, *Monthly variation, Conditional instability, Weather mechanisms, Squall lines, Rainfall distribution, Weather patterns, Convection, Tropical regions, Zaria, Nigeria.

Monthly variation, diurnal variation, and thunderstorm-day and rain-day events in the vicinity of Zaria, Nigeria, were analyzed. The results of the diurnal variation analysis indicate that the thunderstorm regime is an 'afternoon evening' type. Explanations for the afternoon-evening nature of thunderstorms over a continental zone such as Zaria are complex. No single hypothesis is capable of explaining the evening maximum thunderstorm activity over Zaria. An explanation is suggested here in which conditional instability, which is nearly always present in the tropics, combines with a diurnal cycle of convection to produce thunderstorms. The timing of convection of Zaria is controlled principally by the passage of disturbance lines or squall lines. With the passage of a disturbance line, there is always a sharp decrease in temperature and an increase in relative humidity. A high rate of generation of squall lines has been observed in the Jos Plateau of Nigeria, mainly in the afternoon. Because the Jos Plateau is only 200 km east of Zaria, the disturbance lines(s) formed in the region would pass over Zaria mostly in the afternoon-early evening period, thus accounting for a sizeable proportion of the thunderstorms in this area. (Rochester-PTT)
W86-04509

AIRBORNE MERCURY IN PRECIPITATION IN THE LAKE SUPERIOR REGION,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W86-04525

FOURIER INFERENCE: SOME METHODS FOR THE ANALYSIS OF ARRAY AND NON-GAUSSIAN SERIES DATA,
California Univ., Berkeley. Dept. of Statistics.
For primary bibliographic entry see Field 7C.
W86-04530

STUDIES OF THE EFFECTS OF COLD FRONTS DURING THE RAINY SEASON IN ZIMBABWE,
Meteorological Office, Bulawayo (Zimbabwe).
A. V. Smith.
Weather WTHRAL, Vol 40, No. 7, p 198-203, July 1985. 2 fig, 1 tab, 2 ref.

Descriptors: *Zimbabwe, *Rainfall, *Satellites, *Barometric pressure, South Africa, Mozambique, Zambia, Infra-red imagery, Summer, Weather patterns.

Synoptic occasions that produce the major part of Zimbabwean rainfall were studied by the following means: (1) daily Meteostat infra-red satellite photographs covering February 1978 until April 1979; 700 millibar wind patterns and surface pressure gradients from Durban, South Africa to Beira, Mozambique; and rainfall charts, from which the number of stations reporting over 25 mm of rain daily were totalled for every day. Changes in surface pressure gradients from Durban to Beira were correlated with the number of stations recording over 25 mm of rainfall. The surface pressure surges on the Natal Coast (Durban) reflect the intensity of cold fronts/trough affecting South Africa. The major increase in rainfall over Zimbabwe occurs as the 24-hour pressure changes reach Natal and are therefore best predicted by a prebaratic chart for the next day. Satellite pictures indicate that most of the rainfall over Zimbabwe reflects developments over South Africa (apart from the occasional tropical disturbance moving west into Zimbabwe from the Mozambique Channel). The amount of annual rainfall over Zimbabwe is thus related to the intensity and vigor of the cold fronts affecting Durban each summer season. Rainfall is greatest when the meridional flow is greatest. (Rochester-PTT)
W86-04557

EXCEPTIONALLY HEAVY SPRING RAINS IN SYDNEY,
D. White.
Weather WTHRAL, Vol. 40, No. 7, p 210-212, July 1985. 3 fig.

Descriptors: *Weather pattern, *Rainfall, *Australia, Barometric pressure, Rainfall intensity, Sydney.

Between 5 and 12 November 1984, Sydney, Australia, had 471 mm of rain, or just under 40% of its annual average. The nearby suburban of Randwick had 628 mm of rain in the same week. This was the wettest week in Sydney in this century; on three separate occasions in the space of four days parts of Sydney received 2-hr rainfalls that, based on past records, would have a return period of well in excess of 100 yr. An isohyet map of Sydney and its suburbs, synoptic charts for Australia, and upper-air (500 mbar) charts are included that cover early-mid November 1984. (Rochester-PTT)
W86-04558

INTERNATIONAL CORRELATION BETWEEN SEA LEVEL AIR PRESSURE AND RAINFALL IN THE BRITISH ISLES - NORTH SEA REGION,
P. L. Woodworth.
Weather WTHRAL, Vol. 40, No. 9, p 285-292, September 1985. 2 fig, 3 tab, 5 ref.

Descriptors: *Weather patterns, *Rainfall, *Barometric pressure, *England, *Scotland, *North Sea, *England, Sea level pressure, Rainfall measurements, Principal components analysis, Rainfall estimator.

The correlation between annual means of sea level barometric pressure (SLP) and rainfall was sought in long-term weather records at 21 stations in the British Isles-North Sea area. More than 30 yr of data were available for most stations. Anticorrela-

tions between SLP ranged from -0.35 to -0.72 at the 21stations, with an average of -0.58. The magnitude of the anticorrelation varies from station to station owing to the large amount of 'local variability' contained in the individual monthly mean rainfall and, to a lesser extent, SLP records. 'Regionally representative' time series of rainfall and SLP, obtained by principal components analysis (PCA) of data from a geographical spread of stations, were even more strongly anticorrelated throughout the year, with a maximum anticorrelation of -0.90 in October-November, although the proportionality between rainfall and SLP changes from month to month. A PCA of British Isle-North Sea SLP could therefore be considered a highly efficient regional 'rainfall estimator' over long time scales. (Rochester-PTT)
W86-04560

INTEGRATED ANALYSIS OF ACIDIFICATION IN EUROPE,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W86-04589

SIMPLE STOCHASTIC MODEL OF THE PRECIPITATION PROCESS,
Uppsala Univ. (Sweden). Meteorologiska Institutionen.
H. Alexandersson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 12, p 1285-1295, December 1985. 11 fig, 3 tab, 18 ref.

Descriptors: *Precipitation, *Mathematical models, *Model studies, *Stochastic process, Mathematical studies, Precipitation intensity, Convective precipitation, Poisson ratio, Rainfall, Sweden, Markov Process.

The compound Poisson-exponential (Cpe) model, a simple and rather general model of the precipitation process is reviewed using some applications and comparisons found in data from Sweden. The Cpa model, which is a continuous stochastic process, links together models simulating time series of precipitation, hitherto as a rule using Markov chains applied to sequences of dry and wet days, and empirical distributions used for integrated amounts or extreme daily amounts. The basic assumptions of the simple Cpe model can be modified to allow for a more realistic description of the precipitation process without losing the natural parameters involved. The modified Cpa process gives a realistic time structure of the true precipitation process as far as daily autocorrelations are concerned. The model can also incorporate memory, making nearby events correlated and no longer independent, or the precipitation process can be separated into two (or more) parts, one describing the convective precipitation, the other the frontal or less intense precipitation. A very fast method of deriving percentiles from a single table for a Cpe distribution is presented. (Geiger-PTT)
W86-04592

CLIMATIC PATTERN ANALYSIS OF THREE- AND SEVEN-DAY SUMMER RAINFALL IN THE CENTRAL UNITED STATES: SOME METHODOLOGICAL CONSIDERATIONS AND A REGIONALIZATION,
Illinois Univ. at Urbana-Champaign. Dept. of Atmospheric Sciences.
M. B. Richman, and P. J. Lamb.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 12, p 1325-1343, December 1985. 9 fig, 3 tab, 85 ref, append. NSF Grant ATM 81-00158.

Descriptors: *Climatology, *Rainfall, *Regional analysis, *Networks, *Meteorological data collection, Analysis of variance, Variability, Seasonal variation, Mathematical studies, Statistical methods, Eigenvectorial methods.

Results of climatic pattern analyses of three- and seven-day summer rainfall totals for the central United States are presented. A range of eigenvectorial methods is applied to 1949-1980 data for a network of 402 stations extending from the Rocky to the Appalachian Mountains and from the Gulf Coast to the Canadian border. The entire domain variance fractions cumulatively explained by the first 10 correlation-based unrotated Principal Components (PCs) and the 10 orthogonally rotated (VARIMAX) criterion. PCs derived from them are identical for the same data. They vary between 35-47%, depending on the data time scale and form. the highly contrasting sets of unrotated and VARIMAX PC spatial loading patterns receive little physical support from analyses performed separately for subareas of the domain or from comparison with the interstation correlation matrix from which they are derived. The VARIMAX PC loading patterns, in contrast, derive strong physical support from those verifications. Each of these patterns emphasizes a relatively strong anomaly in a different part of the domain; they collectively yield a regionalization of the domain into 10 subareas within which three- and seven-day summer rainfall tends to be spatially coherent. The regionalization shows potential for use in crop-yield modeling, short-range weather prediction, and research into climatic variation and change. (Geiger-PTT)
W86-04593

WARM SEASON NOCTURNAL PRECIPITATION IN THE GREAT PLAINS OF THE UNITED STATES,
Arizona State Univ., Tempe. Dept. of Geography.
R.C. Balling, Jr.
Journal of Climate and Applied Meterology JCAMEJ, Vol. 24, No. 12, p 1383-1387, December 1985. 6 fig, 32 ref. NOAA Grant NA84RAA07418.

Descriptors: *Precipitation, *Spatial distribution, *Temporal distribution, *Rainfall distribution, *Diurnal distribution, Thunderstorms, Seasonal variation, Rainstorms, Nebraska, Oklahoma, Texas, Rainfall intensity, Model studies.

This paper identifies temporal and spatial patterns in the diurnal cycle of hourly warm season precipitation events over the Great Plains of the United States. Results from 30 yr of hourly precipitation records from 515 stations indicate that over 60% of all warm season rainfall (> or = 0.25 mm) occurs at night from southern Nebraska to panhandle Oklahoma and portions of northern Texas. The larger precipitation events (> or = 2.54 mm) display a much larger region where 60% of the warm season precipitation occurs at night. Harmonic analysis reveals all remarkably uniform longitudinal gradient in the timing of maximum rainfall frequencies across much of the Great Plains. The more precise identification of these spatial and temporal patterns should be particularly useful in assessing the many theories of nocturnal precipitation in the central United States, verifying numerical precipitation models for the models for the region, and generating rainfall forecasts for various times of the day. (Author's abstract)
W86-04594

SUB-SAHARAN RAINFALL 1981-1984,
Clark Univ., Worcester, MA. Dept. of Geography.
S. E. Nicholson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 12, p 1388-1391, December 1985. 3 fig, 3 tab, 15 ref. NSF Climate Dynamics Grant ATM 821878 and NOAA Contract NA 84AA-H-00007.

Descriptors: *Drought, *Rainfall intensity, *Semiarid lands, *Climatology, *Meteorological data collection, Rainfall distribution, Semiarid climates, Rainfall, Networks, Albedo, Vegetation, Hydrologic data collection, Sahelo-Saharan, Sahel, Soudan, Sahara, Africa.

Evidence is presented from analyses of rainfall fluctuations from the Sahelo-Saharan, Sahel, and Soudan zones from 1901 to 1981 to support the contention that the drought situation in West Africa is continuing and probably intensifying. Rainfall deficits from 1981 through 1984 equal or exceed those of the early 1970's in all three zones. In most cases, rainfall was considerably lower in 1983 than in 1972, the peak drought year of the early 1970's. Rainfall in 1950 was two to three times greater than during the years 1972 and 1983. Although there is yet no sufficient meteorological explanation for the extreme and persistent sub-Saharan droughts, several hypotheses have been offered, mostly based on numerical models. Changes of surface albedo induced by overgrazing may have been a cause of drought conditions in the early 1970's. Other theories suggest that surface changes induced by drought such as depletion of soil moisture or decrease of vegetation cover may feed back upon the atmosphere in such a way as to reinforce the drought. A bimodal cause for sub-Saharan drought involving an atmospheric trigger mechanism and the cause for its persistence has not been ruled out. (Geiger-PTT)
W86-04595

DAILY RAINFALL PROBABILITIES: CONDITIONAL UPON PRIOR OCCURRENCE AND AMOUNT OF RAIN,
Cordoba Univ. (Spain). Escuela Technica Superior de Ingenieros Agronomos.
A. G. Guzman, and W. C. Torrez.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1009-1014, October 1985. 2 fig, 5 tab, 16 ref.

Descriptors: *Rainfall, Stochastic process, *Models, *Markov process, *Monte Carlo method, Probabilistic process, Probable maximum precipitation, Statistical methods, Mathematical studies, Mathematical models, Model studies, Los Angeles, California.

A generalization of the chain-dependent process is proposed to describe daily rainfall. the model utilizes probabilities of rain based on the amount of rain on the preceding day. The model can also accomodate a second order dependence in the Markov chain. the influence of the antecedent amount of rain on the next day occurrence is called feedback. A method for identification of feedback effects in a series of observations is derived and applied to rainfall occurrence at Los Angeles. Performance of the model in reproducing other precipitation patterns, such as maximum daily rainfall or total amount of rainfall in successive day periods, was checked by the Monte Carlo method. Results showed that the stochastic processes coupled with the feedback can give a realistic description of certain meteorological events. (Geiger-PTT)
W86-04623

INFLUENCE OF LOCAL LAND-SURFACE PROCESSES ON THE INDIAN MONSOON: A NUMERICAL STUDY,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
Y. C. Sud, and W. E. Smith.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1015-1036, October 1985. 14 fig, 2 tab, 28 ref. Contract No. NAS5-28074.

Descriptors: *Rainfall, *India, *Monsoons, *Albedo, *Evapotranspiration, *Numerical analysis, Vegetation, Models, Coriolis force, Mathematical studies, Model studies, Mathematical models, Goddard Laboratory for Atmospheres General Circulation Model, Charney's hypothesis, Radiation.

Twelve July integrations were made with the GLAS (Goddard Laboratory for Atmospheres) GCM (General Circulation Model) to investigate the influence of changes in the land-surface fluxes over the Indian subcontinent on the monsoon circulation and rainfall. The runs consisted of an ensemble of three integrations for each of four separate: a control, an experiment with increased land-surface albedo, an experiment with increased land-surface albedo and reduced land-surface roughness, and an experiment with increaseed land-surface albedo, reduced surface roughness and no evapotranspiration. An intercomparison of the ensemble means of monthly fields produced by the experiments with those of the control showed that the Indian Monsoon was significantly weakened by the increase of surface albedo and the

reduction in surface roughness. Higher surface albedo reduced the monsoon rainfall in conformity with Charney's hypothesis; the low surface roughness made the horizontal transport of moisture in the planetary boundary layer (PBL) more westerly, which reduced the cross-isobaric moisture convergence and hence the rainfall over northwestern India while correspondingly increasing it over China. Rainfall was essentially unaltered by the absence of evapotranspiration, because the increased moisture convergence produced by the enhanced sensible heating of the PBL largely compensated for the reduction in evapotranspiration. (Geiger-PTT)
W86-04624

DEDUCING THE MICROPHYSICAL CHARACTER OF PRECIPITATION FROM MULTIPLE-PARAMETER RADAR POLARIZATION MEASUREMENTS,
Applied Research Corp., Landover, MD.
A. R. Jameson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1037-1047, October 1985. 3 fig, 57 ref. NSF Grants NSF ATM-8216847, and NSF ATM-8318355.

Descriptors: *Radar, *Precipitation, *Polarization, *Physical properties, Remote sensing, Meteorological data collection, Rainstorms, Mathematical studies, Micrometeorology, Remote sensing.

Radar polarization measurements are influenced by the distribution of shapes (weighted by the index of refraction) and the fall behaviors of the hydrometeors. In so far as precipitation-sized hydrometeors are symmetric oblates in the Rayleigh-Gans scattering regime, the effects of canting and shapes can in principle, be separated using the co- and cross-polarized backscattered signals at both horizontal and vertical polarizations. These measurements yield estimates of the variance of a two-parameter distribution of canting angles as well as the refractive index weighted estimates of the mean and variance of the shape (axis ratio) distribution. To the extent that hydrometeor asymmetries can be neglected, these quantities provide a possible framework for precipitation identification from radar polarization measurements at long wavelengths. (Author's abstract)
W86-04625

DIURNAL VARIATION OF THUNDERSTORM ACTIVITY IN THE UNITED STATES,
North Carolina Univ. at Chapel Hill. Dept. of Geography.
D. R. Easterling, and P. J. Robinson.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1048-1058, October 1985. 7 fig, 3 tab, 21 ref.

Descriptors: *Diurnal distribution, *Thunderstorms, *Theoretical analysis, *Seasonal variation, Storms, Meteorological data collection, Weather patterns, Harmonic analysis techniques.

Starting times of thunderstorms for 450 stations in the conterminous United States for a 25-year period were analyzed using harmonic analysis techniques. Diurnal variations were expressed as both the time of maximum storm occurrence and the concentration of activity around this time. Distinct seasonal and spatial variations in diurnal activity occur. Analysis of these variations indicates that the country can be divided into nine thunderstorm regions. In the central states the majority of storms occur at night, but storms are frequent at any time. In both the east and the west, there is a marked concentration of storms in the afternoon. In the west and northeast winter storms are rare, while along the Pacific Coast summer thunder is uncommon. It is possible to offer tentative explanations of the variations in each of these regions by linking results of the harmonic analysis to the causal mechanisms of the storms. In winter in inland regions, storms associated with depressions and fronts appear to dominate, while along coastlines sea breeze effects are most important. In the other seasons air mass storms seem to dominate in those regions having an afternoon maximum, although they also play a role in the areas where line thunderstorms, giving a nocturnal maximum, are most important. (Geiger-PTT)
W86-04626

HAILSTONE SIZE DISTRIBUTIONS AND THEIR RELATIONSHIP TO STORM THERMODYNAMICS,
Research Council of Alberta, Edmonton. Atmospheric Sciences Dept.
L. Cheng, M. English, and R. Wong.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1059-1067, October 1985. 6 fig, 7 tab, 17 ref.

Descriptors: *Hail, *Thermodynamics, *Storms, *Mathematical studies, *Particle size, Mathematical equations, Meteorological data collection, Weather, Weather forecasting, Alberta.

Hailstone size distributions have been determined from time-resolved hail samples collected from ten storms that occurred in Alberta in the summers of 1980, 1982 and 1983, and an intercept parameter and slope parameter were obtained for each hail sample. The intercept parameters are related to the slope parameters by a power relationship which equates the intercept parameter to the product of a coefficient parameter (A) and the slope parameter to the exponent power (b), where b is constant from storm to storm, and A depends upon the storm thermodynamics. The value of A increases with the cloud base temperature of the storm and the maximum water mass flux. The derived relationships between hailstone size distributions and storm thermodynamics may greatly facilitate the measurement of hailfall by weather radar and help to evaluate hail suppression programs. (Geiger-PTT)
W86-04627

PHYSICAL RESPONSE OF CONVECTIVE CLOUDS OVER THE SIERRA NEVADA TO SEEDING WITH DRY ICE,
Electronics Techniques, Inc., Auburn, CA.
For primary bibliographic entry see Field 3B.
W86-04628

RELATIONSHIP BETWEEN ACID PRECIPITATION AND THREE-DIMENSIONAL TRANSPORT ASSOCIATED WITH SYNOPTIC-SCALE CYCLONES,
National Center for Atmospheric Research, Boulder, CO.
For primary bibliographic entry see Field 5B.
W86-04629

DISPOSITION OF SILVER RELEASED FROM SOVIET OBLAKO ROCKETS IN PRECIPITATION DURING THE HAIL SUPPRESSION EXPERIMENT GROSSVERSUCH IV. PART II: CASE STUDIES OF SEEDED CELLS,
Clermont-Ferrand-2 Univ., Aubiere (France).
For primary bibliographic entry see Field 3B.
W86-04630

RELATIONSHIP BETWEEN TIBET-TROPICAL OCEAN THERMAL CONTRAST AND INTERANNUAL VARIABILITY OF INDIAN MONSOON RAINFALL,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
C. Fu, and J. O. Fletcher.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 8, p 841-847, August 1984. 4 fig, 4 tab, 33 ref.

Descriptors: *Tropical regions, *Monsoons, *Rainfall, *Water temperature, *Soil temperature, Climatology, Albedo, Correlation analysis, Air temperature, Weather patterns, Mathematical studies, Rainfall intensity.

During the northern summer, the Tibetan Plateau is a heat source for the atmosphere, and the Equatorial Pacific Ocean Cold Tongue (ECT) is a heat sink, both contributing to the thermal forcing of large-scale quasi-zonal atmospheric circulation. For the period 1954-1979, there exists a high correlation between the zonal large-scale sea-land thermal contrast and Indian monsoon rainfall. When the thermal contrast between the Tibetan Plateau and the Equatorial Cold Tongue is strong (sea land oscillation > 0), the monsoon rainfall tends to be large, and when it is weak sea-land oscillation (SLO) < 0, the monsoon rainfall tends to be small. The interannual variability of the Tibetan soil temperature and the eastern Pacific sea surface temperature are of comparable magnitude, but their variations appear to be independent of each other. For the entire period the sea surface temperature in ECT which is far removed from the monsoon region shows much higher correlation with Indian monsoon rainfall variability than does temperature of the Tibetan Plateau, which is much nearer the monsoon region. For the anomalous monsoon years, the ground surface temperature of the Tibetan Plateau and the surface temperature of the Equatorial Cold Tongue make nearly equal contributions to the correlation of SLO with monsoon rainfall. These are generally years of strong thermal contrast. When the thermal contrast is strong (SLO > 0), it is a better indicator of Indian monsoon rainfall than when it is weak (SLO < 0). (Geiger-PTT)
W86-04631

PREDICTIONS BY TWO ONE-DIMENSIONAL CLOUD MODELS: A COMPARISON,
Illinois State Water Survey Div., Champaign.
B. Ackerman, and R.-Y. Sun.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 7, p 617-628, July 1985. 5 fig, 5 tab, 41 ref. NSF Grant ENV77-11527 and NOAA Grant COMM-NARAD 05089.

Descriptors: *Clouds, *Models, *Convective precipitation, *Prediction, *Weather modification, Cloud seeding, Simulation analysis, Artificial precipitation, Model studies, Remote sensing, Comparison studies, Radar, Great Plains Cumulus Model, Temporal distribution, Spatial distribution.

Two one-dimensional steady-state models of cumulus convection in common use in weather modification research, the NOAA Experiemental Meteorology Branch model (EMB) and the Great Plains Cumulus Model (GPCM), differ in their formulations in several ways. Some of the differences arise from the conceptualization of the convective phenomenon which is modeled in each and some from the physical parameterizations utilized. Predictions of cloud top and dynamic modification potential (seedability) by the two models for 57 midday radiosondes in the Midwest, differed significantly, with the EMB values consistently higher. GPCM simulations provided a better overall estimate of observed radar echo tops, while EMB consistently overestimated, by largest amounts when tops were below 12 km. Study of the impact of temporal and/or spatial separation between sounding and cloud area emphasizes the need, in the Midwest, to consider factors other than thermodynamic stratification (e.g., forced lifting, convergence) on the synoptic and mesoscale when applying the model for prediction of cloud development. However, it was also found that the average difference in predictions by the two models, for the same sound, was of the same order as the average difference in predictions arising from spatial or temporal separation. (Author's abstract)
W86-04632

AIRBORNE DOPPLER RADAR OBSERVATIONS OF A CONVECTIVE STORM,
National Severe Storms Lab., Norman, OK.
P. S. Ray, D. P. Jorgensen, and S.-L. Wang.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 7, p 687-698, July 1985. 12 fig, 6 ref. NSF Grant ATM-8403452.

Descriptors: *Doppler radar, *Storms, *Meteorologic data collection, *Convective precipitation, *Error analysis, Data collections, Networks, Remote sensing, Mathematical studies, Statistical methods, Statistical analysis, Wind velocity, Radar, Florida.

Airborne Doppler radar can collect data on target storms that are quite widely dispersed. However, the relatively long time required to sample an individual storm in detail, particularly with a single aircraft, and the amplification of the statistical uncertainty in the radial velocity estimates when Cartesian wind components are derived, suggests that errors in wind fields derived from airborne Doppler radar measurements would exceed those from a ground based radar network which was better located to observe the same storm. Error distributions for two analysis methods (termed Overdetermined and Direct methods) are given and discussed for various flight configurations. Both methods are applied to data collected on a sea breeze induced storm that occurred in western Florida on 28 July 1982. Application of the direct solution, which does not use the continuity equation, and the overdetermined dual-solution, which requires the use of the continuity equation, resulted in similar fields. Since the magnitude of all errors are unknown and the response of each method to errors is different, it is difficult to assess overall which analysis performs better, indeed each might be expected to perform best in different parts of the analysis domain. A flexible collection strategy can be followed with different analysis methods to optimize the quality of resulting synthesized wind fields. (Author's abstract)
W86-04633

RETRIEVAL OF PRECIPITABLE WATER FROM BHASKARA-II MICROWAVE MEASUREMENTS AND ITS COMPARISON WITH NOAA-7 AND RADIOSONDE DATA,
Indian Space Research Organization, Ahmedabad. Space Applications Centre.
For primary bibliographic entry see Field 7B.
W86-04653

RAINFALL AND EPIZOOTIC RIFT VALLEY FEVER,
Food and Agriculture Organization of the United Nations, Kabete (Kenya). Veterinary Research Lab.
For primary bibliographic entry see Field 5G.
W86-04663

2C. Snow, Ice, and Frost

SEA ICE DYNAMICS AND REGIONAL METEOROLOGY FOR THE ARCTIC POLYNYA EXPERIMENT (APEX) - BERING SEA 1985,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
C. H. Pease, M. Reynolds, G. A. Galasso, V. L. Long, and S. A. Salo.
NOAA Technical Memorandum ERL PMEL-64, October 1985. 120 p, 18 fig, 20 ref, 4 append.

Descriptors: *Sea ice dynamics, *Sea ice, *Ice, *Meteorological data collection, *Bering Sea, Arctic, Polar regions, St. Lawrence Island.

The physical processes in the atmosphere, sea ice, and ocean in the vicinity of St. Lawrence Island, in the northern Bering Sea, were investigated. The interaction of a wind-created polynya with regional dynamics and thermodynamics were observed. Ice drifted toward the south and west across most of the Bering Sea shelf from mid-February until the beginning of May 1985 due to a prolonged period of northerly winds. The net drift pattern of sea ice from the northern Bering Sea was from the north to the south. This is compared with earlier studies in which the net drift was from the north Bering Sea toward the Chukshi Sea. This contrast points out the enormous interannual variations in ice transport in this area and suggests that it is possible that the winter ice direction may change through the Bering Strait from year to year. (Halterman-PTT)
W86-03903

MONITORING CHANGES IN TOTAL AND UNFROZEN WATER CONTENT IN SEASONALLY FROZEN SOIL USING TIME DOMAIN REFLECTOMETRY AND NEUTRON MODERATION TECHNIQUES,
Department of Agriculture, Ottawa (Ontario).
For primary bibliographic entry see Field 2G.
W86-04305

CLOSED-SYSTEM FREEZING OF SOIL IN EARTH DAMS AND CANALS,
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
For primary bibliographic entry see Field 8E.
W86-04336

RADIO ECHO-SOUNDING STUDIES OF ENGLACIAL WATER MOVEMENT IN VARIEGATED GLACIER, ALASKA,
Washington Univ., Seattle. Geophysics Program.
R. Jacobel, and C. Raymond.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 22-29, 1984. 6 fig, 1 tab, 6 ref. NSF Grant DPP 8200725.

Descriptors: *Radiosondes, *Englacial water movement, *Glaciers, *Alaska, Variegated Glacier, Radiation, Flow velocity, Flow pattern, Flow rates, Cavitation, Hydraulics.

Radio-echo returns from internal reflectors were monitored for three weeks during surge motion on Variegated Glacier, Alaska in July 1982. A monopulse transmitter with 3 MHz center frequency was fixed on the glacier surface near the equilibrium line. Data were recorded on magnetic tape approximately three times daily and contain both amplitude and phase information. The frequency spectrum of returned radiation from englacial scatters shows peaks in the 12 to 30 MHz range which places constraints on the size and geometry of the scatterers. Timing of variations in the amplitude and frequency of returned radiation were found to coincide with changes in glacier velocity, basal water pressure, and surface melt rate. These changes in the echo pattern are interpreted in terms of the redistribution of water in englacial channels and cavities connected to the bed some distance down-glacier. This connection has large hydraulic resistance compared to a bore hole connected vertically to the bed. The inflow of water to the cavities from surface melt and rain and the drainage are generally in equilibrium except in times of changed surface input and during surge pulses. In the latter case, water may fill these cavities due to increased pressure at the bed associated with the motion pulse. The information obtained is therefore complementary to bore-hole water pressure levels but cannot duplicate it. This is apparently due to fundamental differences in the hydraulics of the natural cavity and conduit system, and a bore hole connected vertically to the bed. (Author's abstract)
W86-04350

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. I. FJALLSJOKULL (SOUTH-EAST ICELAND): BULK MELT WATERS WITH CLOSED-SYSTEM CHARACTERISTICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
R. Raiswell, and A. G. Thomas.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 35-43, 1984. 7 fig, 3 tab, 24 ref. NERC Grant GR3/3343.

Descriptors: *Glaciohydrology, *Melt waters, *Solute transport, *Fjallsjokull Glacier, *Iceland, Glacial streams, Dissolved cations, Alkalinity, Sulfates, Hydrogen ion concentrations, Closed systems, Solutes, Carbon dioxide.

The glacier at Fjallsjokull, drains through deep valleys cut in the flanking mountains. The width of the glacier ranges from 1.5 km to 4 km. Samples were taken from an area just north of the glacier where the steep ice front is paralleled by the main melt water stream, which is fed by a series of tributaries emerging with force from various portals. Variations in dissolved cations, total alkalinity, sulphate, and field pH are recorded for samples of precipitation, supraglacial melt, and bulk melt waters (those emerging at the portal) from Fjallsjokull (south-east Iceland). The composition of supraglacial melt indicates derivation from precipitation by the acquisition of solutes from the weathering and dissolution of rock debris, in a system open to atmospheric carbon dioxide. Bulk melt waters have variable compositions, approaching saturation with calcite, which can be derived from supraglacial melt water by continued solute acquisition in a system closed to atmospheric carbon dioxide. Solute/discharge relationships at Fjallsjokull are complex. A simple mixing model between dilute englacial water (derived from, and compositionally similar to, supraglacial melt) and more concentrated subglacial water only applied over intermediate discharges (0.5-0.9 m3 s-1), where variations in the composition of either component are small compared to variations in their mixing ratio. Time-dependent chemical reflections occur after mixing and exert significant effects on composition at either discharge extreme. (Lantz-PTT)
W86-04351

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. II. ARGENTIERE (FRENCH ALPS): BULK MELT WATERS WITH OPEN-SYSTEM CHARACTERISTICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
A. G. Thomas, and R. Raiswell.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 44-48, 1984. 2 fig, 1 tab, 17 ref. NERC Grant GR3/3343.

Descriptors: *Glaciohydrology, *Melt waters, *Solute transport, *Argentina, *France, Open systems, Kinetics, Sediment-water interfaces, Carbon dioxide, Calcium, Bicarbonate, Solutes, Hydrogen ion concentration.

Chemical models for the evolution of glacial melt waters suggest that kinetic factors exert a critical control on the nature and magnitude of sediment-water interactions and thus on the composition of bulk melt waters. Solute acquisition in the glacial system may follow two distinct chemical pathways, where CO2 dissolution is the principal source of the H(+) consumed during the weathering and dissolution of rock minerals. The paper describes the chemical evolution of bulk melt waters with open system characteristics (rates of CO2 consumption by weathering lower than rates of renewal by dissolution. Glacier d'Argentiere is on the south-west side of the Chamonix valley, in the Mont Blanc massif of the French Alps. All the bulk melt waters were collected from a site approximately 150 m down-stream from the glacier snout. The melt waters were sampled at approximately hourly intervals for 10 hr (from 10.00 to 20.00 h) in April 1975, and for 36 h (from 7.00 to 19.00 h) in September 1976. Results indicate that the nature of the dissolved load in bulk melt waters from glacier d'Argentiere is essentially uniform under both autumn high-flow, and spring recession-flow conditions. In both cases, Ca(2+) (70-80%) and HCO3 (80-90%) are the major ions. The bulk melt waters are close to equilibrium with atmospheric CO2 and display the characteristic open-system relationship between solute load and pH. The magnitude of the dissolved load in bulk melt waters is considerably higher under recession-flow conditions. Subglacial melt waters are similar in their total dissolved load to the recession-flow samples, but are comparatively depleted in Ca(2+) and enriched in Na(+) and K(+). The development of open- or closed-system characteristics depends on whether dissolution/weathering reactions occur when chemically aggressive englacial waters are mixed with solute and sediment-rich subglacial melt. Occurrence of dissolution/weathering reactions leads to closed-system conditions; otherwise open systems are observed. Such closed-system characteristics may be modified by re-equilibration with atmospheric CO2 or groundwater mixing to give bulk melt waters with open-system characteristics. (Lantz-PTT)
W86-04352

CHEMICAL MODELS OF SOLUTE ACQUISITION IN GLACIAL MELT WATERS,
University of East Anglia, Norwich (England).

School of Environmental Sciences.
R. Raiswell.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 49-57, 1984. 8 fig, 31 ref.

Descriptors: *Melt waters, *Chemical models, *Solute transport, Earth-water interfaces, Hydrogen ion concentration, Carbonates, Dissolved cations, Carbon dioxide, Closed systems, Open systems, Weathering, Equilibrium.

Relatively little attention has been directed toward identifying the nature and controls of solute acquisition by water-rock interactions in the glacial system. Previous work has suggested that cations are acquired by desorption from suspended sediment, while others have shown that the relative abundance of different cations is determined by their rates of leaching from silicate minerals and replacement by hydrogen ions. It has also been shown that pH exerts a significant influence on water-rock interactions in melt waters, as they do in general on most weathering reactions. In surface waters, pH is principally controlled by carbonate equilibria, which can only be quantified by analysis for cations, dissolved carbonate species and pH. It is the purpose of the paper to present chemical models which define the controls of solute acquisition by glacial melt waters in terms of carbonate equilibria. Chemical models for the evolution of bulk melt waters can be constructed by assuming that rock mineral weathering and solute acquisition are controlled by carbonate equilibria. Different open- and closed-system models are defined by variations in the rates of weathering relative to the rate of hydrogen-ion supply by the dissolution and dissociation of CO2 and can be recognized by characteristic pH and sigma (+) relationships. The observed and inferred compositions of englacial and subglacial melt suggest that mixing is unlikely to be conservative and that closed-system conditions result where post-mixing weathering reactions occur. The final composition of bulk melt waters is determined by the mixing ratio between englacial and subglacial melt, the extent of post-mixing evolution, and opportunity for mixing with ground waters or re-equilibration with the atmosphere. (Lantz-PTT)
W86-04353

INSTRUMENTS AND METHODS. FIELD PH DETERMINATIONS IN GLACIAL MELT WATERS,
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04355

OPTIMIZATION OF A SNOW NETWORK BY MULTIVARIATE STATISTICAL ANALYSIS,
Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
G. Galeati, G. Rossi, G. Pini, and G. Zilli.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 93-108, March 1986. 7 fig, 2 tab, 15 ref.

Descriptors: *Network design, *Clustering, *Principal component analysis, *Water equivalent, *Snow surveys, Alps, Italy, Cost analysis, Statistical Methods.

Snow cover measurement data in the northeastern Alps (Italy) were analyzed in order to select a reduced number of measurement stations from which to evaluate the water equivalent amount. The selection was based on cluster methods for identification of homogeneous areas and on principal components analysis for individualization of representative stations. This analysis shows clearly that about 30% of the operating stations can be ignored and, if necessary, their values drawn from their more closely associated stations. The results obtained for the years 1983 and 1984, which were not included in the original analysis, were practically identical, confirming the validity of the selection made. The reduction in number of stations allows, with the same results, immediate savings in terms of human and technical resources. The stations not discarded can be more accurately controlled with regard to quantity and quality of measurements and the more significant stations could be used for further analysis or for forecasting. (Rochester-PTT)
W86-04395

SNOW CHEMISTRY OF THE CASCADE-SIERRA NEVADA MOUNTAINS,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-04442

FIELD AND LABORATORY MEASUREMENTS OF SNOW LIQUID WATER BY DILUTION,
California Univ., Santa Barbara. Dept. of Geography.
R. E. Davis, J. Dozier, E. R. LaChapelle, and R. Perla.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1415-1420, September 1985. 3 fig, 2 tab, 15 ref, 2 append. NAS5-27463, NAS5-328, ngt-803.

Descriptors: *Conductivity, *Snowmelt, *Dilution method, *Glaciohydrology, *Water content, Field tests, Physical properties.

Field trials of the dilution technique for measuring snow liquid water content show that the procedure is rapid and simple. Measurements of the liquid water mass fraction with an absolute error of approximately 1.5% can be obtained by one operator at a rate of 10-15 samples per hour, but if the water content is low (0-2%), the relative error can be high. Electrolytic conductivity is the preferred method of measuring concentrations, using a stock solution of 0.01 Normal HCl. The recommended amount of stock solution to add is 0.5-0.8 times the mass of the snow sample. Extraction of the resulting mixture of stock solution and snow liquid water is best done with a screened pipette, instead of by decanting. (Appendixes on error analysis and porosity, liquid water saturation, and volume fraction computations are included.) (Author's abstract)
W86-04540

INTERCEPTION OF SNOW BY THE FOREST CANOPY,
Tennessee Div. of Health Planning, Nashville.
A. F. Kolesov.
Soviet Soil Science SSSCAE, Vol. 17, No. 4, p 123-126, July-August 1985. 2 tab, 5 ref. Translated from Pochvovedniye, No. 8, p 136-138, 1985.

Descriptors: *Snow surveys, *Forests, *Tree crowns, *Water-equivalent, *Hydrologic budget, Square-Meter Plot Method, Spruce, Deciduous Forests, USSR.

Studies at the Istra hydrologic station (USSR) demonstrated that the portion of the snow intercepted by tree crowns and then falling to the soil surface during windy periods and warm spells amounts to 10-15% of the total amount of snow falling in winter. This amount is not accounted for by standard snow-survey methods. A method ('square-meter plot method') is proposed for estimating snowfall. Compared to the square-meter plot method, which accounts for all the snow, including that fallen from the tree crowns, standard instruments underestimate the water equivalent of snow in pure spruce plantations by as much as 15-16% and under deciduous plantations by as much as 5%. This value must be taken into account in water-budget computations. This is not the same as 100% of the snow intercepted by tree crowns, of which 55-60% represents pure losses (evaporation) and 40-45% reaches the soil surface and participates in all hydrologic processes. (Rochester-PTT)
W86-04555

HIGH DENSITIES, WATER EQUIVALENTS, AND MELT RATES OF SNOW IN THE CAIRNGORM MOUNTAINS, SCOTLAND,
Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.
Weather WTHRAL, Vol. 40, No. 9, p 272-277, September 1985. 3 fig, 1 tab, 8 ref.

Descriptors: *Snow depth, *Snow density, *Scotland, Seasonal distribution, Melting, Snowmelt, Snowpack, Cairngorm Mountains.

Depths and densities of snow were measured at several snow courses above Glen Feshie during the winter and spring of 1984. Snow densities were very high by British standards at all sites on all dates. Even fresh-looking powder snow had a density around 0.27 g/cu cm, and mean densities for old snow increased from 0.44 in February to 0.47 in mid-March, 0.51 at the start of April, and 0.63 in late April and mid-May. Estimated water equivalents showed a more complicated spatial and temporal pattern. Differences of up to 250 mm water equivalent were maintained between two sites on opposite sides of the same ridge (N vs S), and the overall range over the season varied considerably among sites. Mean point melt rates were in the range 8-23 mm water equivalent/day during the 3-29 April period and 18-31 mm water equivalent per day during the 29 April-13 May period. The results of this study highlight several features of the Cairngorm snowpack: great spatial variability in accumulation, high densities of old snow, very high water equivalents that do not reach peak values until early April, and sustained high melt rates thereafter. (Rochester-PTT)
W86-04559

2D. Evaporation and Transpiration

POTENTIAL EVAPORATION AND FIELD WATER CONSUMPTION IN THE NORTH CHINA PLAIN,
Academia Sinica, Beijing (China). Inst. of Geography.
C. Weixin.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 271-287, 7 fig, 3 tab, 5 ref.

Descriptors: Water transfer, *Water supply, *Diversion, *China, Water supply development, Evaporation, Water supply development, Irrigation.

Potential evaporation and field water consumption in the North China Plain are estimated as part of the overall assessment of the south-north water transfer project planned for eastern China. The methods for estimating the potential evaporation are provided. The estimates of these values show that at the present state of agricultural technology, natural moisture conditions fail to satisfy agricultural requirements. These findings indicate that the area north of the Huang He should be the key water importing region. (Halterman - PTT)
W86-03937

EVAPOTRANSPIRATION AND SOIL WATER RELATIONSHIPS FOR SPRING WHEAT AND SOYBEAN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
L. J. Brun, L. Prunty, J. K. Larsen, and J. W. Enz.
Soil Science SOSCAK, Vol. 139, No. 6, p 547-552, June 1985. 4 fig, 3 tab, 13 ref.

Descriptors: *Evapotranspiration, *Soil-water-plant relationships, Wheat, Soybeans, Statistical models, Soil water, Lysimeters, Root zone, Plant water.

Nonlinear models to statistically analyze the relationship between evapotranspiration and soil water content at variable levels of potential evapotranspiration were studied. Using precision weighing lysimeters, daily evapotranspiration for spring wheat (Triticum aestivum L.) and soybean (Glycine max (L.) Merrrill) was obtained. Soil water content in the root zone was measured by neutron attenuation. For purposes of analysis, the highest volumetric water content within the root zone was used as the indicator of available water to the plant. Similarly, pan evaporation was used as an index of potential evapotranspiration. Eight models were tested, using pan evaporation, soil water content, or both to predict evapotranspiration. The R-square values obtained were 0.89 for wheat and

0.76 for soybean. The two simple variables do a good job of predicting evapotranspiration and describing the relationship of soil water content and potential evapotranspiration to actual plant water use. (Lantz-PTT)
W86-04407

WATER-LIMITED EQUILIBRIUM OF SAVANNA VEGETATION SYSTEMS,
Massachusetts Inst. of Tech., Cambridge.
For primary bibliographic entry see Field 2I.
W86-04545

INFLUENCE OF LOCAL LAND-SURFACE PROCESSES ON THE INDIAN MONSOON: A NUMERICAL STUDY,
National Aeronautics and Space Administration, Greenbelt, MD. Lab. for Atmospheric Sciences.
For primary bibliographic entry see Field 2B.
W86-04624

RELATIONSHIP BETWEEN TIBET-TROPICAL OCEAN THERMAL CONTRAST AND INTERANNUAL VARIABILITY OF INDIAN MONSOON RAINFALL,
Cooperative Inst. for Research in Environmental Science, Boulder, CO.
For primary bibliographic entry see Field 2B.
W86-04631

2E. Streamflow and Runoff

MODEL ANALYSIS OF GROUND WATER IN THE SAN LUIS VALLEY, COLORADO, U.S.A.,
Geological Survey, Louisville, KY.
For primary bibliographic entry see Field 2A.
W86-03977

METHODS OF HYDROLOGICAL COMPUTATIONS FOR WATER PROJECTS.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 7A.
W86-04000

CONSIDERATIONS ABOUT WATER MINERALIZATION OF SOME MOZAMBICAN RIVERS,
Direccao Nactional de Aq
J. Suschka.
Aqua AQUAAA, No. 1, p 19-24, 1986. 13 fig, 1 tab.

Descriptors: *Water quality, *Rivers, *Mozambique, *Mineralization, Salinity, Total dissolved solids, Water level fluctuations, Saline water intrusion, Limpopo River.

The salinity of the main Mozambican rivers has been examined. Most of the river waters turned out to have a salinity below 200 mg total dissolved solids (TDS/1), while a few water courses had a salinity below 50 mg TDS/l. Rivers subjected to great fluctuations in flow are affected in the dry season by back flow of saline sea water, sometimes to an extent of 20 to 40 km. Attention is drawn to the direct effects of extensive water use for agriculture and the indirect effects through water storage, on the water mineralization increase. In particular cases like the Limpopo river basin, further water development construction, can affect the water quality adversely and limit the water use for agricultural purposes. (Author's abstract)
W86-04151

TOPOGRAPHIC PARTITION OF WATERSHEDS WITH DIGITAL ELEVATION MODELS,
Hunter Coll., New York. Dept. of Geology and Geography.
For primary bibliographic entry see Field 4A.
W86-04157

PERSISTENCE IN THE SIZE DISTRIBUTION OF SURFICIAL BED MATERIAL DURING AN EXTREME SNOWMELT FLOOD,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2J.
W86-04173

STOCHASTIC MODEL OF SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz, and L. M. Watada.
Water Resources Research WRERAO, Vol. 22, No. 3, p 296-302, March 1986. 7 fig, 2 tab, 13 ref, 1 append. NSF Grant No. CEE-8300928.

Descriptors: *Stochastic models, *Seasonal runoff, *Runoff forecasting, Markov Process, Snowmelt, Snake River, Idaho, Bayesian models, Model studies, Actual runoff.

Each year the National Weather Service and the Soil Conservation Service issue a monthly sequence of five (or six) categorical forecasts of the seasonal snowmelt runoff volume to describe uncertainties in these forecasts for the purposes of optimal decision making, a stochastic model is formulated. A Bayesian Markov model of a sequence of categorical forecasts of the seasonal snowmelt runoff volume has been developed. The model provides a formal description of forecast uncertainties for the purposes of optimal decision making. The most likely class of decision problems to benefit from this model are Markov decision processes, which can fit into a discrete-time, finite, continuous-space, nonstationary Markov process. Posterior densities of the actual runoff conditional upon a forecast, and transition densities of forecasts are obtained from a Bayesian information processor. Parametric densities are derived for the process with a normal prior density of the runoff and a linear model of the forecast error. The structure of the model and estimation procedure are motivated by analyses of forecast records from five stations in the Snake River basin, from the period 1971-1983. The advantages of supplementing the current forecasting scheme with a Bayesian analysis are discussed. They are: (1) The format of the current forecasts, to which users have become accustomed, is preserved; (2) The credible interval has attached to it an explicit probability which can be set at any desired level; (3) The information contained in the forecast specifies completely the posterior density; and (4) The posterior density provides necessary information for optimal decision making and economic evaluation of forecasts. (Lantz-PTT)
W86-04192

OPTIMAL WATER SUPPLY PLANNING BASED ON SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 6B.
W86-04194

LOW-COST SYSTEM TO REMOTELY MEASURE PIEZOMETRIC HEAD,
M. E. Schaefer, and H. F. Hemond.
Ground Water Monitoring Review, Vol. 6, No. 2, p 87-91, Spring 1986. 3 fig, 1 ref.

Descriptors: *Piezometric head, *Remote control, *Cost analysis, Piezometers, Measuring instruments, Computers, Temperature effect, Data transmission, Salt marshes, Radios, Data acquisition.

A low-cost rapid response system to remotely collect piezometric head data in compressible porous media has been constructed. The system is based on low-cost temperature compensated pressure transducers, standard low-cost CMOS logic devices, low-cost commercially available two-way radios and a portable microcomputer. The basic system operation involves encoding a pressure transducer output, which is then transmitted on command via two-way FM radios to a base station located up to one-half mile away. The base station includes a TRS-80 Model 100 microcomputer which controls the network of remote stations and decodes and stores the information. The system has been field-tested using one nest of four piezometers. The system range in the marsh was about 1/2 mile for line-of-sight transmission and 1/4 mile when trees and shrubs interfered. One of the four piezometers was used as a control by opening both ports of the transducer to the atmosphere. In all field tests, there is a slight dip in the data for the control piezometer, which seems to result from temperature changes over the period of the test. This data collection system can also be used to monitor any set of environmental instruments that have a voltage output that can be scaled to 1 to 6 volts. This allows measurements of salinity, wind speed and direction, tide, or other environmental parameters to be made. As many as 16 nest of four instruments each can be sampled with the current setup. It is also possible to modify the system for long-term measurements by turning the non-essential circuitry off and on as needed. Because the Model 100 has a built-in modem, it could be connected to a telephone line in the field and operated remotely. Other modifications may be envisioned that further expand the realm of applicability of this system. (Lantz-PTT)
W86-04214

DIAGNOSTIC HYDROLOGY,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-04277

MIXING OF A STRATIFIED RIVER BY BARGE TOWS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
For primary bibliographic entry see Field 5G.
W86-04306

SOLUTION TO THE KINEMATIC WAVE APPROACH TO OVERLAND FLOW ROUTING WITH RAINFALL EXCESS GIVEN BY PHILIP'S EQUATION,
Washington Univ., Seattle. Coll. of Forest Resources.
T. W. Cundy, and S. W. Tento.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1132-1140, August 1985. 9 fig, 4 tab, 14 ref, 1 append.

Descriptors: *Kinematic wave theory, *Overland flow, *Rainfall, *Mathematical models, Flow pattern, Mathematical studies, Algorithms, Models, Mathematical equations, Rainfall-runoff relationships, Infiltration.

A solution to the kinematic wave equations for overland flow routing where the lateral inflow term is determined from a constant rainfall rate and the infiltration model of Philip is presented. The solution uses the methdo of characteristics, and while it is not completely analystical, it reduces to a simple numerical procedure requiring only a Newton method or similar algorithm. The analysis presented deals with both the rising and falling stages. Example calculations, water surface profiles, and hydrographs are illustrated. The method may also serve as a test for finite difference schemes designed to solve the more difficult problem of unsteady, nonuniform lateral inflow, since at least parts of the solution are known analytically. (Geiger-PTT)
W86-04310

MOMENTS OF CATCHMENT STORM AREA,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-04316

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 1. THEORY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2A.
W86-04317

ERRORS AND PARAMETER ESTIMATION IN PRECIPITATION-RUNOFF MODELING. 2. CASE STUDY,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2A.
W86-04318

EVALUATION OF THORNTHWAITE'S WATER BALANCE TECHNIQUE IN PREDICTING STREAM RUNOFF IN COSTA RICA,
Instituto Tecnologico de Costa Rica, Cartago. Dept. de Ingenieria Forestal.
J. C. Calvo.
Hydrological Sciences -- Journal -- des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 51-60, March 1986. 2 fig, 2 tab, 15 ref.

Descriptors: *Hydrologic budget, *Thornthwaite water balance method, *Stream discharge, *Statistical analysis, *Rio Macho, *Costa Rica, Confidence intervals, Runoff.

The Thornthwaite water balance technique was used to predict monthly stream runoff from the Rio Macho basin in Costa Rica. The method was tested by comparing observed and predicted runoff over a 15 water-year period. The study shows that this method provides mean annual and monthly estimates in close agreement with measured values. Generally these mean estimated values fall between the 90% confidence intervals for the measured runoff. These results indicate that the Thornthwaite method can be satisfactorily applied to estimate mean monthly streamflow in the uplands of Costa Rica. (Author's Abstract)
W86-04393

PERIODIC AUTOREGRESSIVE-MOVING AVERAGE (PARMA) MODELING WITH APPLICATIONS TO WATER RESOURCES,
Geological Survey, Denver, CO.
A. V. Vecchia.
Water Resources Bulletin WARBAQ, 21, No. 5, p 721-730, October 1985. 2 fig, 4 tab, 16 ref.

Descriptors: *Streamflow time series, *Model studies, *Model selection criteria, *Multivariate analysis, *Fourier analysis, Mathematical models.

Results involving correlation properties and parameter estimation for autoregressive-moving average models with periodic parameters are presented. A multivariate representation of the PARMA model is use to derive parameter space restrictions and difference equations for the periodic autocorrelations. Close approximation to the likelihood function for Gaussian PARMA processes results in efficient maximum-likelihood estimation procedures. Terms in the Fourier expansion of the parameters are sequentially included, and a selection criterion is given for determining the optimal number of harmonics to be included. Application of the techniques is demonstrated through analysis of a monthly streamflow time series. The PARMA model provides a powerful tool for modeling hydrologic time series that are observed at time resolutions smaller than one year. Maximum-likelihood estimation of PARMA models through the procedure set forth here involves little more computational difficulty than estimation with standard PARMA models. (Rochester-PTT)
W86-04529

PARAMETRIC/NONPARAMETRIC MIXTURE DENSITY ESTIMATION WITH APPLICATION TO FLOOD-FREQUENCY ANALYSIS,
Texas Univ. at El Paso. Dept. of Mathematics.
E. Schuster, and S. Yakowitz.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 797-804, October 1985. 4 fig, 3 tab, 31 ref. NSF CEE-81-10889, DPP-82-19439.

Descriptors: *Mathematical models, *Statistical methods, *Flood peak, *Flood frequency, Simulation analysis, Hypothesis testing.

Nonparametric density estimation methodology is suggested as a means of sidestepping the dilemma of choosing a model in analysis of peak annual flows in the context of flood frequency analysis. Simultaneously, the authors recognize that the standard nonparametric estimators preclude the use of prior information and related data and, furthermore, have virtually no tail at all. They offer a remedy for these inadequacies by introducing an estimator that mixes parametric and nonparametric density estimates. The procedure allows incorporation of prior information, experience, and regional data information, but provides a safeguard against incorrect model choice. Pointers are offered on implementation of the suggested procedures and the results of a simulation study are described. Application to the regionalization problem is outlined and some connections with hypothesis testing are discussed. (Rochester-PTT)
W86-04531

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: I. REVIEW, ALGORITHM, AND SIMULATION EXPERIMENTS,
Halff (Albert H.) Associates, Inc., Dallas, TX.
M. J. Bergman, and J. W. Delleur.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 815-826, October 1985. 4 fig, 4 tab, 31 ref.

Descriptors: *Streamflow forecasting, *Mathematical models, *Forecasting, Simulation analysis, Hydrologic models, Statistical methods.

State space techniques and Kalman filtering are applied to the class of autoregressive (AR) models for real-time flow forecasting. State-space formulation is reviewed and an adaptive algorithm is discussed that estimates model parameters, system noise statistics, and measurement noise statistics simultaneously with the state variables (stream flows). To estimate the parameters, the filter operates alternately in the state space and the parameter space. Estimation of the noise statistics involved linearization of the measurement equation. The procedures made explicit use of the optimality properties of the Kalman filter. The several cases presented showed good estimation and forecasting capabilities. This was confirmed by analysis of an innovation sequence, which indicated near optimal filter behavior. Model parameter estimates were improved compared to others commonly used in hydrology, such as least squares and maximum likelihood estimators. This was due to noise in the observations. (see also W86-04534)(Rochester-PTT)
W86-04533

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: II APPLICATION TO THE POTOMAC RIVER,
Halff (Albert H.) Associates, Inc., Dallas, TX.
M. J. Bergman, and J. W. Delleur.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 827-832, October 1985. 4 fig, 3 tab, 11 ref.

Descriptors: *Forecasting, *Streamflow forecasting, *Mathematical models, Statistical method, Simulation analysis, Potomac River, Hydrologic models.

State space formulation and Kalman Filtering were applied to the general class of autoregressive models. Methodologies pertaining to the estimation of parameters and noise statistics were applied to the daily flows of the Potomac River. The results from the implementation of the model to the forecasting of daily river flows up to four days ahead are reported. The use of Kalman filtering techniques could result in an overall reduction of mean square forecast error compared to non-filtering techniques (maximum likelihood method). This trend was not always consistent for all forecast periods investigated, however. (see also W86-04533)(Rochester-PTT)
W86-04534

2F. Groundwater

SHALLOW GROUNDWATER RESOURCES OF THE HUANG-HUAI-HAI PLAIN,
Z. Yanhua, and Z. Xianglin.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 257-270, 3 fig, 2 tab.

Descriptors: *Diversion, *Water transfer, *China, Agriculture, Industrial water, Water use, Water supply, Water supply development, Basins.

As part of the assessment of the proposed south-north water transfer project in eastern China, the shallow groundwater resources of the Huang-Huai-Hai Plain is described, and the hydrogeological problems along one of the proposed routes of the project is discussed. Although the shallow groundwater resources of the basin are not excessive, a tremendous potential remains. It is suggested that this could satisfy the requirements of agriculture and industry in the near future. (Halterman - PTT)
W86-03936

CONTRIBUTION OF ISOTOPE TECHNIQUES IN THE DETERMINATION OF THE RELATIONSHIP SURFACE WATER/GROUNDWATER IN BANGLADESH (GANGES AND BRAHMAPUTRA AREAS),
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 2A.
W86-03969

GROUND-WATER MODELS, VOLUME I: CONCEPTS, PROBLEMS, AND METHODS OF ANALYSIS WITH EXAMPLES OF THEIR APPLICATION.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
The UNESCO Press: Paris, France, 1982. 235 p.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, Aquifers, Mathematical models, Alluvial fans, Karst, Artesian basins, Recharge.

The use of models for studying groundwater is explored. General information includes human activities which influence groundwater, the mathematical framework of models, types of groundwater models, methods of solution (analytical, stochastic, discretized, analog), management models, and adaptability of models for developing countries. Twenty-one case histories of model applications are presented. These are grouped into several categories: alluvial valleys, mountain valleys, alluvial fans, large phreatic aquifer fans, fractured rock, karst, and small artesian basins. (Cassar - PTT)
W86-03974

APPLICABILITY OF MODELS TO ALLUVIAL VALLEYS: ARKANSAS RIVER VALLEY, COLORADO, U.S.A.,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 2A.
W86-03975

MODEL OF THE AQUIFERS IN THE LLOBREGAT DELTA (CATALONIA, SPAIN),
Curso International de Hidrolgia Subterranea, Barcelona (Spain).
E. Custodio.
IN: Groundwater-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 39-51, 5 fig, 11 ref.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, *Rivers, Llobregat River, Spain, Aquifers, Coastal aquifers, Saline water intrusion, Groundwater depletion, Water supply.

A model was developed to study the aquifers of the Llobregat Delta near Barcelona, Spain. The two-layer system has a semipermeable layer which isolates the two aquifers in the central coastal area of the delta. There is only a single aquifer in the sides and lower end of the valley. The system is surrounded by impermeable material, which limits the flow of water from the alluvial deposits up-

stream. Both aquifers contact the seabed in places. The water supply in this region of high population and extensive groundwater withdrawal is believed to be near its limit. Modeling results indicated that with the present withdrawal situation, a period of three consecutive dry years would make it impossible to maintain withdrawals for more than two years. However, at the end of a sequence of three consecutive dry years followed by two wet years, the groundwater levels would recover. Human interventions such as channeling and increased regulation of upriver dams would produce the same result. The aquifer system could not support an increase in pumping rate of 15 cu hm/yr. (Cassar - PTT)
W86-03976

AQUIFER OF ULLUM-ZONDA VALLEY (ARGENTINA),
United Nations, New York.
A. A. Navarro, and J. A. Pazos.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 67-72, 2 fig, 2 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, Aquifers, Recharge, Reservoirs, Ullum Valley, San Juan Valley, Argentina, Groundwater recharge, Dams, Reservoirs.

Three digital models were used to simulate the groundwater regime of the uninhabited Ullum-Zonda Valley, Argentina. This region is upstream from the agricultural San Juan Valley, which requires additional irrigation water. A dam is planned to transfer water from the Ullum Valley to San Juan Valley. Results indicated that the reservoir, inundating 13 sq km of land, was necessary if water is pumped continuously from the Ullum well field. This would create additional recharge in the complex hydraulic system, river-reservoir-aquifer-wells. (Cassar - PTT)
W86-03978

SAN JOSE DEL CABO, BAJA CALIFORNIA, NARROW VALLEY AQUIFER,
Universidad Nacional Autonoma de Mexico, Mexico City.
C. V. Cruickshank.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 73-78, 3 fig, 3 ref.

Descriptors: *Groundwater *Model studies, Aquifers, Coastal aquifers, Saline water intrusion, San Jose del Cabo, Mexico.

Aquifer behavior was modeled in the semiarid San Jose del Cabo Valley, Baha California, to study pumping rates and well locations. Salt water intrusion was prevented with an alternative which extracted up to 20 million cu m/yr with wells located in the downstream end of the valley, but not too close to the sea (the closest well was 4 km from the coast). Larger extractions could have been obtained by locating the wells further upstream; however, pumping levels would then have been too low and the water volume exploited far in excess of the estimated recharge. (Cassar - PTT)
W86-03979

ASSESSMENT OF EXPLOITABLE GROUND-WATER RESOURCES OF THE SOKH DEBRIS CONES,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
I. V. Garmanov.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 79-83, 1 fig, 3 ref.

Descriptors: *Hydrologic models, *Groundwater, *Model studies, *Alluvial fans, *Debris cone, Aquifers, Infiltration, Recharge, Sokh debris cone, USSR.

Debris cones (alluvial fans) are found where mountain streams emerge upon a plain or intermountain area. The Sokh debris cone in the Soviet Union was studied by a mathematical model to provide information on groundwater exploitation. Located in an old irrigated agricultural area, the cone consists of several zones: (1) a zone of surface runoff infiltration and groundwater transit, (2) a zone in which permeable deposits wedge out, (3) a zone of poor unconfined groundwater, (4) a zone of shallow unconfined groundwater. The main source of recharge is infiltration. Several aquifers, some artesian, are present in the lower part of the cone. Patterns of groundwater movement and recharge are complex, with confined and unconfined conditions. The hydrogeological conditions vary not only down the slope but also laterally across the slope. Model results showed that the seasonal and perennial groundwater regime in the confined aquifers is determined by the surface water discharge. Calculations of data from the Sokh debris cone established that the average discharge of the groundwater flow formed in the zone of the surface runoff infiltration for the period 1955-1956 averaged 27 cu m/sec, of which 18 cu m/sec returned to the surface in the zone of pinch out. Later, in the 1960's, after many irrigation canals were concrete-lined in the zone of surface infiltration, the average annual discharge of the groundwater flow was reduced by 4 cu m/sec and the groundwater discharge in the zone of pinch out by 7 cu m/sec. (Cassar - PTT)
W86-03980

APPLICABILITY OF MODELS TO A LARGE AQUIFER: THE OGALLALA FORMATION OF COLORADO,
Geological Survey, Denver, CO.
R. R. Luckey.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 85-91, 2 fig, 10 ref.

Descriptors: *Groundwater mining, *Model studies, *Hydrologic models, Ogallala Aquifer, Colorado.

Modeling of the Ogallala formation in Colorado predicted water level declines to the year 2000 under several pumping regimes. Projected water level declines ranged from nearly zero in areas of little or no development to nearly 40 m in areas of maximum projected development. Maps were drawn to indicate those areas in which irrigation would soon no longer be practical. These coincided with the areas which were heavily developed prior to regulation of the groundwater system. Large areas will have less than 30 m of saturated thickness remaining by the year 2000. This is the minimum amount required for irrigation development. (Cassar - PTT)
W86-03981

PREDICATION OF CHANGES IN NATURAL GROUND-WATER RESOURCES OF A LARGE REGION (KAZAKH SSR),
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
A. A. Konoplyantsev, and S. M. Semenov.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 93-96, 1 fig, 2 ref.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, Recharge, Groundwater recharge, Kazakh, SSR, USSR.

A model was applied to the groundwater resources of the steppe-desert of the Kazakh SSR, where cities, industry, irrigated agriculture, and stock breeding are the principal water users. A map shows predicted changes in natural unconfined groundwater resources over the 2.8 million sq km area. (Cassar - PTT)
W86-03982

RADIOACTIVE AND CHEMICAL WASTE MIGRATION IN THE SNAKE RIVER PLAIN AQUIFER, IDAHO NATIONAL ENGINEERING LABORATORY,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5B.
W86-03983

CHANGES IN GROUND-WATER RESOURCES AS A RESULTS OF MINE DRAINAGE IN THE SEVEROURALSK BAUXITE AREA,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
Z. P. Lebedyanskaya.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 123-130, 5 fig, 5 ref.

Descriptors: *Groundwater movement, *Mine drainage, *Model studies, *Hydrologic models, Severouralsk mine, Drainage, Geohydrology, Karst, Aquifers, USSR.

Integrated application of a stochastic model of a karstic basin and a network analog model permitted the solution of a number of practical problems associated with bauxite mining in the Severouralsk area (USSR), namely: (1) to evaluate a change in the groundwater regime due to mine drainage and to predict changes in the water resources in the region caused by future mining; (2) to predict the changes in the groundwater balance at different stages of mining; (3) to evaluate possible general mean inflow into the system of mine works at design depths to 1000 m; (4) to show the expediency of diverting a river in a karst area, thereby to evaluate the hydrogeological efficiency of this measure and to identify the river bed sections to be isolated; and (5) to recommend a rational scheme for draining deep aquifers providing outflow through drainage systems, galleries, and pumping wells. (Author's abstract)
W86-03984

ASSESSMENT OF EXPLOITABLE GROUND-WATER RESOURCES ON THE BASIS OF MEASUREMENTS OF SPRING FLOW,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
M. A. Khordikainen.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 131-136, 3 fig, 1 ref.

Descriptors: *Groundwater, *Springs, *Karst, Crimea, Filtration springs, Perennial springs, Fluation springs, Karst hydrologu, USSR.

The springs of the southern coast of Crimea serve as a water supply for the population. Discharge measurements involved 85 springs. The area is composed of Jurassic karstic limestones. One series measured discharges 10 times a month for 3 to 24 years. The other statistics were obtained once during the low water period, both for high and low water years. Mathematical analysis revealed the reliable resources from filtration-type springs, mixed-type springs, and floation-type springs. Filtration-type springs have very small variations in the amplitude of discharge. They are perennial. Floation-type springs have a much greater variability in discharge. They react quickly to precipitation, usually 1-3 days, sometimes 5-10 days. Mixed-type springs have discharges more like filtration springs but with greater amplitude. Both filtration- and mixed-type springs have a peak discharge in February-March, then a smooth decrease in discharge takes place. In karstic regions the exploitable groundwater resources are much less than the mean perennial discharges. For the filtration-type springs this difference is not more than 2-10 fold; for mixed-type springs, 4-20 fold; and for floation-type springs, 40-50 fold. (Cassar - PTT)
W86-03985

MODELING OF THE SUBSIDENCE OF VENICE,

Centro di Ricerca IBM di Venezia (Italy).
For primary bibliographic entry see Field 6G.
W86-03987

SIMULATED OIL-SHALE MINE DEWATERING USING A CONFINED MULTIAQUIFER MODEL, PICEANCE BASIN, COLORADO, U.S.A.,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 4C.
W86-03988

MODELING OF GROUND-WATER HYDROLOGY IN THE HOUSTON DISTRICT, TEXAS,
Kansas State Geological Survey, Lawrence.
D. G. Jorgensen.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 167-176, 4 fig, 1 tab, 10 ref.

Descriptors: *Groundwater, *Environmental effects, *Subsidence, *Hydrologic models, *Model studies, Soil compaction, Compaction, Houston, Texas, Aquifers.

Groundwater withdrawal and its effect on hydrology in the Houston, Texas, area were modeled, using two analog models and a digital model. Problems encountered in this region are water level decline, land subsidence, and salt water intrusion. Three aquifers are present: Chicot (upper), Evangeline (underlying Chicot and the most important water source), and the Burkeville confining layer. The second, more refined analog model simulated water level declines and quantity of water resulting from clay compaction with a high degree of accuracy. It also simulated, to a reasonable degree, the total amount of water derived from clay compaction. The digital model correctly simulated head in both aquifers, the quantity of water resulting from clay compaction, and the correct spatial distribution of the compaction (subsidence). Figures illustrate the groundwater withdrawals from 1890 to 1976 and predicted withdrawals to 1981, decline in the altitude of the potentiometric surface in the Evangeline aquifer (up to 120 cm), and land subsidence (up to 210 cm). A table lists the volume of water derived from clay compaction and the total groundwater pumped during several periods between 1980 and 1964. The compaction ratios (compaction divided by water pumped) are 0.17 to 0.22. (Cassar - PTT)
W86-03989

ANALOGUE MODEL OF THE CHAD BASIN,
Kwara State Water Corp., Ilorin (Nigeria).
J. U. Uzoma.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 183-192, 2 fig, 1 tab, 3 ref.

Descriptors: *Groundwater, *Model studies, *Surface-groundwater relationships, Chad, Africa, Artesian basins, Hydrographs, Confined aquifers, Analog models, Aquifers.

An electric analog model of the Chad Basin aquifer (chiefly Pleistocene deposits) was constructed in 1968 to help in the operation and management of the groundwater resources of the basin. Confined groundwater exists in the sand bodies within the quaternary argillaceous sequence. Flowing artesian wells are common here. Drilling of boreholes and other field exploration tests identify three aquifer zones: the upper or shallow, largely unconfined aquifer; the middle zone, which has the most important yield; and the lower zone, which has a lesser yield than the middle zone. No hydraulic intercommunication exists between the confined aquifer and Lake Chad. However, the shallow aquifer receives seasonal recharge from surface waters. The analog model of the Chad Basin artesian aquifer has been described as hypothetical and best suited for demonstration. Problems with the model are lack of sufficient data. The model could have greater use if the enormous amount of data that have accrued is incorporated. (Cassar - PTT)
W86-03991

MODEL OF THE TERMINAL COMPLEX OF THE OUED R'HIR (ALGERIA),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
A. Levassor.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 193-204, 4 fig, 3 tab, 4 ref.

Descriptors: *Groundwater *Model studies, *Hydrologic models, *Irrigation requirements, Oued R'hir Valley, Algeria, Date palms.

Model studies of the Oued R'hir region of Algeria were conducted to assess the groundwater reserves, considering that slow depletion in this date-growing region appears inevitable. A four-year plan to plant and irrigate 10,000 additional hectares of palm groves and to improve irrigation practices cannot be achieved with the water resources in this region alone. For the year 2000 the projected maximum withdrawals are less than half of the projected requirements. Since dates require a large amount of water (4000 to 6000 cu m) to produce 1 ton of dates, it is suggested that development de-emphasize agriculture. (Cassar - PTT)
W86-03992

GROUND-WATER BALANCE IN THE AQUITAINE BASIN,
Ecole Nationale des Ingenieurs de Tunis (Tunisia).
M. Besbes, G. de Marsily, and M. Plaud.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 205-217, 4 fig, 8 tab, 8 ref.

Descriptors: *Groundwater, *Model studies, *Hydrologic models, Aquitaine basin, France.

Aquitaine, the largest sedimentary basin in France and the most abundant source of groundwater, has been exploited for more than a century. This report summarizes the past ten years' efforts to forecast groundwater flow patterns using digital models. Modeling has added considerably to the knowledge of basin hydrology. One figure illustrates the computed head for 1965 in the Eocene level (layer 4). Another figure diagrams the steady-state gains and losses corresponding to groundwater layers in 1965. (Cassar - PTT)
W86-03993

ASSESSMENT OF EXPLOITABLE RESOURCES OF FRESH WATER LENSES IN ARID REGIONS,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
V. A. Babuahkin.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 229-234, 3 fig, 6 ref.

Descriptors: *Groundwater, *Hydrologic models, *Model studies, *Lenses, Yashkanian Lens, Turmenian, USSR, Wells, Injection wells, Aquifers.

An electric analog model was used to study the groundwater resource of the fresh water lenses in arid regions of the USSR, specifically the Yaskhanian lens in Turkmenia. Paired wells, used to prevent salt water intrusion, have been operated in the Yaskhanian water system for 15 years at a rate computed to be about 20% of the total exploitable resources. During operation the fresh-salt water interface was practically stable. Around the discharging wells a cone of depression with a drawdown of 3-4 m was formed. The size of the cone did not exceed 4-5 km. Model results confirmed these data. (Cassar - PTT)
W86-03995

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH: PROCEEDINGS.
Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
National Center for Ground Water Research, Houston, Texas. (1985). Edited by Norman N. Durham and Ann E. Redelfs. 222 p.

Descriptors: *Groundwater quality, *Groundwater contamination, *Path of contamination, *Water quality control, *Groundwater protection, Water quality, Water chemistry, Fate of pollutants.

This conference addresses many groundwater quality issues which have become of public concern, with the recent increase in public awareness of the potential problems of groundwater pollutants and contaminants. The conference emphasized physical, chemical and biological processes that control the movement and fate of contaminants in the subsurface. New and improved processes and methodologies were discussed and coordinated with biotic and abiotic molecular transformation processes. Transport processes and sorption procedures exhibited new concepts and philosophies. Information presented should be an aid to water quality research programs, where the techniques and methodologies discussed may be put to practice. (Lantz - PTT)
W86-04042

MICROBIOLOGICAL PARAMETERS CONTROLLING PLUGGING OF WELLS AND GROUNDWATER SYSTEMS,
Regina Water Research Inst. (Saskatchewan).
D. R. Cullimore.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 12-14, 16 ref.

Descriptors: *Water well plugging, *Clogging, *Obstruction to flow, *Groundwater movement, *Wells, Biofilm, Groundwater barriers, Gallionella, Bacteria, Heterotrophic bacteria, Biochemical tests.

The plugging of well screens and the neighboring interstitial zones of the aquifer can be microbiological in origin. In Saskatchewan, most microbial plugging is a direct result of biofilm generation. Microbiological examination of the wells revealed a diverse group of bacteria involved. These have been differentiated into three groups: (1) Gallionella, (2) other bacteria able to deposit iron or manganese oxides or hydroxides in or around the cell, and (3) heterotrophic bacteria able to grow in a biofilm. The major factors which are involved in developing a predictive formula for the risk of plugging are organic carbon, total iron, total manganese, total Kjeldahl nitrogen, pH, temperature and bacterial loading. A Plugging Risk Factor (P.R.F.) is under development. (Author's abstract)
W86-04045

ISOLATION AND GROWTH OF 'NATURALLY OCCURRING' BACTERIA FROM GROUND WATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
L. D. Stetzenbach, N. A. Sinclair, and L. M. Kelley.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 28-29, 2 fig, 1 tab, 13 ref.

Descriptors: *Groundwater, *Bacteria, *Microbiological studies, Aquifers, Acinetobacter, Flavobacterium.

Ground water is an increasingly significant source of potable water and is one of the least studied ecosystems. Assessment of man's impact on this resource requires knowledge of the 'naturally occurring' microbial populations. Since ground water from deep protected aquifers is generally assumed to be oligotrophic, a low nutrient medium (R2A) was selected for the primary isolation and enumeration of bacteria from well water. Of the 500 isolates recovered, >80% were Gram negative, non-motile, rod shaped bacteria. These organisms were identified according to the three tube method

of Lassen. Acinetobacter spp. predominated and comprised 59% of the total isolates. Moraxella spp., Flavobacterium supp., and an unidentified, oxidase negative, pigmented bacterium (PO) were also present. Direct counts using epifluorescent microscopy revealed that representative isolates grew significantly (4 orders of magnitude) in filtered well water. Enrichment of well water with low concentrations (100 microgm carbon/liter or 1000 microgm carbon/liter) of glucose, acetate, succinate or pyruvate enhanced the growth of the PO and Acinetobacter isolates. (Author's abstract)
W86-04049

GROUNDWATER CONTAMINATION AT CONROE WASTE DISPOSAL SITE,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-04054

IRREVERSIBLE SORPTION OF TRACE LEVEL ORGANICS BY GROUND WATER HUMIC SUBSTANCES: A NEW MECHANISM OF TRANSPORT,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-04055

ORGANIC SOLUTE TRANSPORT IN GROUNDWATER DISCHARGE ENVIRONMENTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04056

CHEMICAL TRANSFORMATIONS IN GROUNDWATER,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
For primary bibliographic entry see Field 2B.
W86-04057

GEOCHEMICAL INVESTIGATIONS INTO GROUNDWATER POTENTIAL CONTAMINANTS RESULTING FROM UNDERGROUND COAL GASIFICATION (UCG),
Ground Water Sampling, Inc., Englewood, CA.
For primary bibliographic entry see Field 5B.
W86-04058

DISTRIBUTION OF SELECTED TRACE ORGANICS IN THE LEACHATE PLUME OF A MUNICIPAL LANDFILL,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04059

FACTORS INFLUENCING THE SURVIVAL OF VIRUSES IN GROUND WATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 5B.
W86-04060

REMOVAL OF IRON AND MANGANESE FROM GROUND WATER WITH THE VYREDOX METHOD,
Ground Water Associates, Inc., Arlington, MA.
For primary bibliographic entry see Field 5G.
W86-04061

SALINE CONTAMINANTS IN THE GROUNDWATERS OF EASTERN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04062

MODELING GROUND WATER TRANSPORT AT CONROE CREOSOTE WASTE SITE,
National Center for Ground Water Research, Norman, OK.
For primary bibliographic entry see Field 5B.
W86-04063

GEOHYDROLOGY SURROUNDING A POTENTIAL HIGH LEVEL NUCLEAR WASTE REPOSITORY IN THE PALO DURO BASIN, TX,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
M. A. Deyling, P. G. Smith, and L. Picking.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 91-94, 6 fig, 1 tab, 6 ref.

Descriptors: *Groundwater pollution, *Radioactive wastes, *Groundwater movement, *Geohydrology, Aquifers, Radionuclides, Waste storage, Palo Duro Basin, TX.

The Palo Duro Basin of the Texas Panhandle is being investigated as a potential high level nuclear waste repository site. As groundwater is the most likely mechanism for radionuclide movement, it is desirable to locate a repository in a hydrologic regime which is favorable for waste isolation and containment. The Palo Duro Basin consists of deep brine aquifers of low regional permeability underlying a thick Permian age evaporite section. Overlying the Permian age evaporites are the Dockum and Ogallala fresh water aquifers. Observed potentiometric data in the principal aquifers indicate a potential for downward flow from the surficial aquifers to the deep brine aquifers. Groundwater movement in these deep aquifers is very slow. Modeling efforts indicate flow times of hundreds of thousands to over a million years for groundwater to reach the basin margins. Investigative methods have included drill-stem testing similar to oil field methodology, modified drill-stem testing with tools developed for low-permeability formations and long term production tests similar to conventional water well pumping tests. Testing has generally indicated permeability of .1-10 millidarcies in the water transmitting units. (Author's abstract)
W86-04064

ADVECTION AND RETARDATION IN AN EXPERIMENTAL PLUME OF SORBING AND NON-SORBING SOLUTES,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04065

CONTRIBUTIONS TO THE FATE OF UNDERGROUND ORGANIC CONTAMINANTS DURING UNDERGROUND PASSAGE,
Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
For primary bibliographic entry see Field 5B.
W86-04066

ASSESSING THE QUALITY OF GROUNDWATER NEAR A COASTAL PLAIN USED FOR AGRICULTURE AND DISCHARGE OF SEWAGE,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5B.
W86-04067

ONE-DIMENSIONAL MATHEMATICAL MODEL OF VIRUS TRANSPORT,
Holzmacher, McLendon and Murrell, Melville, NY.
For primary bibliographic entry see Field 5B.
W86-04068

TRANSPORT OF HALOGENATED ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04071

MODEL TO EVALUATE SALT WATER INTRUSION DUE TO DIFFERENT CONJUNCTIVE USE STRATEGIES IN COASTAL AQUIFERS IN SAUDI ARABIA,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04072

IMPROVED NUMERICAL MODELLING OF CONTAMINANT TRANSPORT IN SATURATED AQUIFERS,
North Carolina Univ. at Charlotte.
For primary bibliographic entry see Field 5B.
W86-04073

GROUNDWATER POLLUTION IN NORTHWEST ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04074

PHYSICAL TRANSPORT PROCESS FOR HYDROCARBONS IN THE SUBSURFACE,
Underground Resource Management, Inc., Austin, TX.
For primary bibliographic entry see Field 5B.
W86-04075

DELINEATING GROUNDWATER CONTAMINATION BY HOUSEHOLD WASTEWATER,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5A.
W86-04076

VIRAL AND BACTERIAL CONTAMINATION OF GROUNDWATER BY ON-SITE WASTEWATER TREATMENT SYSTEMS IN SANDY COASTAL SOILS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W86-04077

FINITE ANALYTIC METHOD FOR SOLUTION OF ONE-DIMENSIONAL TRANSIENT TRANSPORT EQUATIONS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04079

DEVELOPING INFORMATION ON ALDICARB LEVELS IN LONG ISLAND GROUNDWATER,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W86-04080

SPRINGS ARE MORE EFFICIENT AND RELIABLE THAN WELLS FOR MONITORING GROUND WATER QUALITY IN MOST LIMESTONE TERRAINS - A CONSEQUENCE OF TRANSPORT PROCESSES OCCURRING IN CONDUITS,
National Park Service, Mammoth Cave, KY.
For primary bibliographic entry see Field 5B.
W86-04081

SEAWATER INTRUSION IN THE SAN JUAN ISLANDS,
San Diego State Univ., CA. Dept. of Natural Science.
For primary bibliographic entry see Field 5B.
W86-04083

SUBSURFACE TRANSPORT OF URBAN RUNOFF POLLUTANTS,
Arizona Univ., Tucson.

For primary bibliographic entry see Field 5B.
W86-04084

FINITE ELEMENT METHOD WITH REGION WISE ITERATION SCHEME FOR SOLVING GROUNDWATER SOLUTE TRANSPORT EQUATION,
Oak Ridge National Lab., TN.
For primary bibliographic entry see Field 5B.
W86-04085

SOME CONCEPTS PERTAINING TO INVESTIGATIVE METHODOLOGY FOR SUBSURFACE PROCESS RESEARCH,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W86-04086

STATISTICAL EXAMINATION OF SMALL-SCALE SPATIAL VARIABILITY OF VOLATILE ORGANIC COMPOUNDS AND INORGANIC ANIONS IN GROUNDWATER,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04089

SAMPLING ANALYTICAL CONCERNS IN VOLATILE ORGANIC CONTAMINANT STUDIES,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 5A.
W86-04090

IN-SITU DETERMINATION OF DISPERSION COEFFICIENTS AND ADSORPTION PARAMETERS FOR CONTAMINANTS USING A PUSH-PULL TEST,
Insitu Consulting, Laramie, WY.
For primary bibliographic entry see Field 5B.
W86-04092

IDENTIFICATION OF SUBSURFACE BRINES USING STATISTICAL TECHNIQUE,
National Inst. of Hydrology, Roorkee (India).
For primary bibliographic entry see Field 5A.
W86-04093

MINIMIZING PROBLEMS CAUSED BY UNEQUAL DEVELOPMENT OF BIOLOGICAL ACTIVITY WITHIN COLUMN MICROCOSMS USED TO PREDICT THE FATE OF POLLUTANTS IN SUBSURFACE MATERIALS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5A.
W86-04095

QUANTIFYING GROUNDWATER STORAGE AND INTERACTION IN A MULTI-LAYERED ALLUVIAL AQUIFER,
Agricultural Research Service, Durant, OK.
J. W. Naney, D. C. Kent, M. R. Hemann, and R. Neafus.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 199-202, 4 fig, 2 tab, 6 ref.

Descriptors: *Groundwater storage, *Alluvial aquifers, *Hydraulic properties, Hydrology, Wells, Irrigation wells, Aquifers, Pumping tests, Washita River, Anadarko, Oklahoma.

Comparisons are made between total penetration wells and those completed in selected layers of the Washita River alluvium near Anadarko, Oklahoma in order to determine the effects of layered lithology on aquifer yield. The hydraulic characteristics developed from analysis of core samples from individual sand and silt layers within the alluvium are used to estimate groundwater storage and movement within the alluvium. Pumping tests of a nearby total penetration irrigation well and those from research test wells are compared in order to relate yield determined by analytical techniques to that of a producing well. Aquifer test results are presented for wells in specific layers. A unique relationship between the D50 grain size and the permeability within each layer is demonstrated which makes it feasible to use the laboratory test, rather than the more expensive pumping test to determine permeability. The results of the multilayered and homogeneous cases are compared using a map of transmissivity residuals which indicates areas of reduced storage within nearly 70,000 acres of aquifer during a 20 year period of simulated pumping in the Washita River alluvium. (Author's abstract)
W86-04096

USE OF ELECTRICAL RESISTIVITY METHOD TO STUDY VERTICAL HYDROLOGIC BOUNDARIES IN WADI SUDR, SINAI PENINSULA, EGYPT,
King Faisal Univ., Al-Hasa (Saudi Arabia). Coll. of Agriculture.
M. A. A. Sayed.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 203-207, 4 fig, 2 tab, 4 ref.

Descriptors: *Electrical properties, *Resistivity, *Vertical flow, *Geohydrologic boundaries, Hydrology, Saline water, Groundwater, Boundary layers, Wells, Wadi Sudr, Sinai Peninsula, Egypt.

The method of electrical resistivity sounding was applied to the Delta of Wadi Sudr in Sinai Peninsula to study, within the upper 25-35 m of Pliocene and Quaternary strata, the relation between the lithologic succession and the presence of both fresh and saline water bearing formations at different depths. Interpretation of the sounding curves indicates that the geoelectric succession in the area corresponds to hydrologic rather than lithologic boundaries. The results indicate that: (1) Four geoelectric layers are recognized which represent the soil zone, aeration zone, fresh water zone and sea water zone. (2) Depths of the boundaries between these zones are 1-2.5 m, 4-10.5 m and 21-17 m respectively from ground surface. (3) Resistivities of the four geoelectric layers are 53-1000 ohm.m, 25-343 ohm.m, 18-120 ohm.m and 5-16 ohm.m respectively. The results obtained show good agreement with the known geologic and hydrologic settings of the area and the method used has proved to be useful in locating vertical hydrologic successions. The results show also that water wells to be drilled in the future in the area should not exceed a depth of 25 m and that pumping rates and periods should be under accurate control as to the change in water quality due to overpumping. (Author's abstract)
W86-04097

SIMPLIFIED GROUNDWATER SAMPLING TECHNIQUES AT LANDFILLS,
Beling Consultants, Inc., Moline, IL.
For primary bibliographic entry see Field 5B.
W86-04098

POROUS FLOW MODEL FOR STEADY STATE TRANSPORT OF RADIUM IN GROUNDWATER,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics.
For primary bibliographic entry see Field 5B.
W86-04159

ORIGIN AND DISTRIBUTION OF SULFATE IN A FRACTURED TILL IN SOUTHERN ALBERTA, CANADA,
Department of Agriculture, Lethbridge (Alberta). Groundwater Section.
For primary bibliographic entry see Field 2K.
W86-04160

REVIEW OF PARAMETER IDENTIFICATION PROCEDURES IN GROUNDWATER HYDROLOGY: THE INVERSE PROBLEM,
California Univ., Los Angeles. Dept. of Civil Engineering.
W. W.-G. Yeh.
Water Resources Research WRERAO, Vol. 22, No. 2, p 95-108, February 1986. 2 tab, 118 ref. NSF Grant Nos. CEE 81B500 and CEE 8301230.

Descriptors: *Geohydrology, *Parametric hydrology, *Inverse problem, *Reviews, Mathematical studies, Evaluation.

The purpose of this survey is to review parameter identification procedures in groundwater hydrology and to examine computational techniques which have been developed to solve the inverse problem. Parameter identification methods are classified under the error criterion used in the formation of the inverse problem. The problem of ill-posedness in connection with the inverse problem is addressed. Typical inverse solution techniques are highlighted; specifically, the (1) generalized matrix method based upon the equation error criterion method, and the (2) Gauss-Newton minimization based upon the output error criterion method. The review also includes the evaluation of methods used for computing the sensitivity matrix (influence coefficient method, sensitivity equation method). Statistics which can be used to estimate the parameter uncertainty are outlined. Attempts have been made to compare and contrast representative inverse procedures, and direction for future research is suggested. (Lantz-PTT)
W86-04164

ESTIMATION OF AQUIFER PARAMETERS UNDER TRANSIENT AND STEADY STATE CONDITIONS: 1. MAXIMUM LIKELIHOOD METHOD INCORPORATING PRIOR INFORMATION,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, and S. P. Neuman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 199-210, February 1986. 3 fig, 80 ref. Research Grant T3770171.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Transient conditions, *Steady-state conditions, *Maximum liklihood method, *Statistical analysis, Inverse problem, Hydraulic properties, Regression analysis.

Some of the advantages in treating the inverse problem in groundwater flow analysis statistically and in regularizing its solution by means of penalty criteria are discussed based on use of prior estimates of the parameters. The inverse problem is posed in the framework of maximum likelihood theory cast in a manner that accounts for prior information about the parameters. Since not all the factors which contribute to the prior errors can be quantified statistically at the outset, the covariance matrices of these errors are expressed in terms of several parameters which, if unknown, can be estimated jointly with the hydraulic parameters by a stagewise optimization process. When transient head data are separated by a fixed time interval, the temporal structure of these data is approximated by a lag-one autoregressive model with a correlation coefficient that can be treated as another unknown parameter. Estimation errors are analyzed by examining the lower bound of their covariance matrix in the eigenspace. Conclusions are drawn which suggest that certain model identification criteria developed in the time series literature, all of which are based on the maximum likelihood concept, might be useful for selecting the best groundwater model (or the best method of parameterizing a particular model) among a number of given alternatives. (see also W86-04175 and W86-04176) (Lantz-PTT)
W86-04174

ESTIMATION OF AQUIFER PARAMETERS UNDER TRANSIENT AND STEADY STATE CONDITIONS: 2. UNIQUENESS, STABILITY, AND SOLUTION ALGORITHMS,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, and S. P. Neuman.

Water Resources Research WRERAO, Vol. 22, No. 2, p 211-227, February 1986. 10 fig, 1tab, 32 ref. Research Grant T3770171.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Transient conditions, *Steady-state conditions, Algorithms, Uniqueness, Stability, Solutions, Ill-posed problems, Conjugate gradient algorithms.

After defining the terms uniqueness, identifiability, and stability, theoretical considerations and synthetic examples are used to demonstrate that ill-posedness of the aquifer inverse problem can be mitigated by including prior information about the parameters in the estimation criterion to be minimized. At the same time, the inclusion of such information is shown to be insufficient to guarantee uniqueness and stability in all cases. Several test problems in the recent literature, which have resulted in pessimistic conclusions about the solvability of the aquifer inverse problem, are shown to be ill-posed; a question is thus raised about the validity of these conclusions in the general case. Various conjugate gradient algorithms, coupled with the adjoint state finite element method for computing the gradient of the estimation criterion, and with Newton's method for determining the optimum step size downgradient, are compared. A marked improvement in the rate at which these algorithms converge is shown to be achieved by switching from one method to another when the former slows down or fails to converge. (see also W86-04174 and W86-04176) (Lantz-PTT)
W86-04175

ESTIMATION OF AQUIFER PARAMETERS UNDER TRANSIENT AND STEADY STATE CONDITIONS: 3. APPLICATION TO SYNTHETIC AND FIELD DATA,
Arizona Univ., Tucson. Dept. of Hydrology and Water Resources.
J. Carrera, and S. P. Neuman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 228-242, February 1986. 16 fig, 18 tab, 14 ref. Research Grant T3770171.

Descriptors: *Groundwater movement, *Aquifer characteristics, *Transient conditions, *Steady-state conditions, *Field tests, *Synthetic data, Model studies, Model testing, Autocorrelation, Eigenspace.

Illustrated and explored are various features of a methodology for solving the inverse problem of aquifer hydrology, by applying it to a synthetic test case and to a set of field data from the southwestern United States. In addition to demonstrating the ability of the method to estimate model parameters under a variety of conditions, the synthetic example is used to investigate the relative worth of transient and steady state data in terms of their ability to bring about an improvement in the quality of the estimates. A similar investigation is performed with regard to the role that prior information may play in reducing the variance of the estimation errors. The paper demonstrates the potential utility of the author's inverse methodology to the optimum design of observation and measurement networks in space and time. Based on a synthetic example, it is shown that the model structure identification criteria previously introduced can be used successfully to choose the best parameter zonation pattern among a number of given alternatives. The field example illustrates a case where one must account for temporal autocorrelation between water level data at a given observation point. By validating the model against data which have not been used for parameter estimation, one finds that the validation results improve when the temporal error structure of the water level data is represented by a lag-one autocorrelation model. Both the synthetic and the field examples are used to obviate the advantages of performing the analysis of the estimation errors in the eigenspace instead of the original parameter space and to relate the results of this analysis to the fundamental questions of identifiability, uniqueness, and stability where appropriate. (see also W86-04174 and W86-04175) (Lantz-PTT)
W86-04176

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: MODEL DEVELOPMENT AND PARAMETER SENSITIVITY,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04190

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: EXPERIMENTAL RESULTS,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04191

FINITE ELEMENT ALGORITHMS FOR SIMULATING THREE-DIMENSIONAL GROUNDWATER FLOW AND SOLUTE TRANSPORT IN MULTILAYER SYSTEMS,
GeoTrans, Inc., Herndon, VA.
P. S. Huyakorn, B. G. Jones, and P. F. Andersen.
Water Resources Research WRERAO, Vol. 22, No. 3, p 361-374, March 1986. 16 fig, 2 tab, 24 ref. E.I. duPont deNemours Contract AX-654761.

Descriptors: *Groundwater movement, *Finite element method, *Algorithms, Aquifers, Flow system, Mathematical analysis, Simulation analysis, Mathematical studies.

A finite element formulation is developed for the simulation of groundwater flow and solute transport in multilayer systems of several aquifers and aquitards. This formulation is general, flexible, and capable of taking full advantage of the nature of flow in such multilayer systems. A fully three-dimensional spatial representation can be performed for certain aquifers or for the entire flow system if needed. Those parts of the system that require three-dimensional spatial discretization are handled effectively by combining two-dimensional basis functions in the x-y space and one-dimensional basis functions in the z space. Furthermore, the formulation has a desirable option to perform one-dimensional representation of flow and transport in aquitards and areal representation of flow and transport in certain aquifers that do not require the fully three-dimensional discretization. When the one-dimensional representation of an aquitard is used, coupling of adjacent aquifer and aquitard layers is handled using a convolution integral approach. A general solution strategy is also developed to allow systematic time stepping and cost-effective matrix handling schemes. For those parts of the system that require three-dimensional discretization, an algorithm referred to as the alternate sublayer and line sweep procedure is presented for decomposing three-dimensional matrix equations. This algorithm can accomodate several thousand nodal unknowns without requiring excessive core storage and CPU time. Four examples of transient flow and transport problems are provided. These examples show verification of numerical results and demonstrate that the present finite element models are far more cost-effective than earlier three-dimensional models that are based on the conventional Galerkin approach and direct matrix solution algorithms. (Author's abstract)
W86-04200

MODELING CONTAMINATION OF SHALLOW UNCONFINED AQUIFERS THROUGH INFILTRATION BEDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04201

INTERPRETATION OF AN UNCONFINED GROUNDWATER FLOW EXPERIMENT,
Cornell Univ., Ithaca, NY. School of Civil and Environmental Engineering.
W. Brutsaert, and A. I. el Kadi.
Water Resources Research WRERAO, Vol. 22, No. 3, p 419-422, March 1986. 4 fig, 8 ref. NSF Grant INT-8213639.

Descriptors: *Groundwater movement, *Unconfined groundwater, *Data interpretation, Experimental data, Water table profiles, Aquifers, Saturation.

A laboratory experiment is considered that was carried out on a sand tank to study the problem of water table geometry during flow to an adjacent stream. The purpose of the analysis is to determine whether the effects of partial saturation and of compressibility are likely to be important in this type of problem. Through numerical simulations and other considerations, it is concluded that compressibility alone, however large, cannot reproduce these experimental results. The results can only be simulated if proper account is taken of the partly saturated flow above the water table. Compressibility effects of aquifer material and of the water may be safely neglected. (Lantz-PTT)
W86-04205

ADAPTATION OF THE CARTER-TRACY WATER INFLUX CALCULATION TO GROUNDWATER FLOW SIMULATION,
Geological Survey, Denver, CO.
K. L. Kipp.
Water Resources Research WRERAO, Vol. 22, No. 3, p 423-428, March 1986. 2 fig, 1 tab, 16 ref.

Descriptors: *Carter-Tracy equation, *Groundwater movement, *Mathematical analysis, Aquifers, Computer models, Boundary processes, Boundary conditions, Flow rates.

The Carter-Tracy calculation for water influx is adapted to groundwater flow simulation with clarifying explanations. The Van Everdingen and Hurst aquifer-influence functions for radial flow from an outer aquifer region are employed. This technique, based on convolution of unit-step response functions, offers a simple but approximate method for embedding an inner region of groundwater flow simulation within a much larger aquifer region where flow can be treated in an approximate fashion. The use of aquifer-influence functions in groundwater flow modeling reduces the size of the computational grid with a corresponding reduction in computer storage and execution time. The Carter-Tracy approximation to the convolution integral enables the aquifer influence function calculation to be made with an additional storage requirement of only two times the number of boundary nodes more than that required for the inner region simulation. It is a good approximation for constant flow rates but is poor for time-varying flow rates where the variation is largely-relative to the mean. A variety of outer aquifer region geometries, exterior boundary conditions, and flow rate versus potentiometric head relations can be used. The radial, transient-flow case presented is representative. An analytical approximation to the function of Van Everdingen and Hurst for the dimensionless potentiometric head versus dimensionless time is given. (Author's abstract)
W86-04206

EFFECTIVE AND INEXPENSIVE GAS-DRIVE GROUND WATER SAMPLER,
GHR Environmental, Inc., New Bedford, MA.
For primary bibliographic entry see Field 5B.
W86-04208

FACTORS WHICH AFFECT SOIL-PORE LIQUID: A COMPARISON OF CURRENTLY AVAILABLE SAMPLERS WITH TWO NEW DESIGNS,
For primary bibliographic entry see Field 5B.
W86-04209

SAMPLING FOR TOXIC CONTAMINANTS IN GROUND WATER,
Kennedy/Jenks Engineers, San Francisco, CA.
For primary bibliographic entry see Field 5B.
W86-04210

LOW-COST APPARATUS FOR ON-SITE MONITORING OF METHANE IN GROUND WATER,
Allegheny Coll., Meadville, PA. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W86-04211

NEW VALVED AND AIR-VENTED SURGE PLUNGER FOR DEVELOPING SMALL-DIAMETER MONITOR WELLS,
Battelle Project Management Div., Richland, WA. Office of Hazardous Waste Management.
For primary bibliographic entry see Field 5B.
W86-04212

USE OF A GEO FLOWMETER FOR THE DETERMINATION OF GROUND WATER FLOW DIRECTION,
ARCO Petroleum Products Co., Houston, TX.
M. Guthrie.
Groundwater Monitoring Review, Vol. 6, No. 2, p 81-86, Spring 1986. 10 fig, 1 ref.

Descriptors: *Flowmeters, *Groundwater movement, *Geo Flowmeter, Landfills, Geohydrology, Water level, Channels, Flow velocity, Flow pattern, Drilling.

This paper is a case history of the use of the Geo Flowmeter (which is used to determine groundwater flow direction and velocity in monitoring wells or open boreholes) in a complex hydrogeologic setting consisting of a partially above grade landfill located between a navigable waterway and a large storm water impoundment basin. Mounding effects of the landfill, tidal changes in the channel, varying water levels in the impoundment basin and a complex substrate (alternating layers of sand, silt and clay) presented a challenge for groundwater interpretation and analysis. The Geo Flowmeter was lowered into existing monitoring wells surrounding the landfill to determine groundwater flow direction and rate. Sensitivity of the meter was sufficient to distinguish two separate flow directions in a single well screen. Later investigation involving installation of piezometers, long-term groundwater level monitoring and plotting of groundwater contours verified initial findings of the meter. When compared to an extensive drilling program, it is relatively inexpensive. In addition, much information can be derived by using the instrument and only a few wells. Disadvantages would include the time and effort it takes to understand and use the instrument properly. The operating manual certainly needs to be more explicit. It must be remembered that in many cases the meter will indicate a very local situation that could be subject to change. For example, the flow in some wells actually reversed because of tidal situations. Not all readings taken during the testing of this instrument were 100% convincing, particularly those taken in open boreholes. In a deep boring, it was very difficult to determine if the instrument was placed in the soil correctly. (Lantz-PTT)
W86-04213

LOW-COST SYSTEM TO REMOTELY MEASURE PIEZOMETRIC HEAD,
For primary bibliographic entry see Field 2E.
W86-04214

DETERMINING HEAD AND PRESSURE DISTRIBUTION IN LOW TRANSMISSIVITY FORMATIONS AND SOILS,
Gartner Lee Associates Ltd., Markham (Ontario).
K. G. Kennedy, S. C. Hollingshead, and R. E. J. Leech.
Ground Water Monitoring Review, Vol. 6, No. 2, p 92-98, Spring 1986. 6 fig, 1 tab, 3 ref.

Descriptors: *Soil water, *Pressure distribution, *Pressure head, Transmissivity, Model studies, Groundwater movement, Permeability coefficient, Drilling, Monitoring, Flow velocity, Data interpretation.

The prediction of groundwater flow system behavior relies on defining the transmissivity and potentials within the individual hydrostratigraphic units that are part of the system. Testing can be done to quantify the transmissivity, generally within a relatively short period of time after drilling or monitoring devices have been installed. However, the ability to determine the heads or pressures in the individual units can take longer periods of time. This is particularly true when the hydraulic conductivity of units is less than about 10 to the -8 m/s. These are commonly the most sought after types of deposits for waste management sites. Two application models were developed to determine the potentials in low transmissivity units. The first model, called headrop, was applied to shallow groundwater flow systems where hydraulic head and average linear velocities were typically of interest in relatively flat-lying layered sequences of low permeability soils. Water levels were measured in the more permeable hydrostratigraphic formations but no such data could be reliably obtained from the tighter clays and clayey till units. A second model, called pressdrop, was applied to deeper groundwater investigations where pressures and fluid densities were measured but no useful fluid level information could be obtained. The following conclusions can be made from the studies done to date with the two models: 1) Long periods of time are required to obtain samples from and measure water levels in tight formations; 2) The head distribution within any flow system can be extrapolated knowing the transmissivity of individual units and the total head drop across the system or between higher permeability formations within the system; 3) The head profile can be used to determine the average linear groundwater velocities and total flux through the system; 4) The pressure profile in any deep groundwater flow system can also be determined knowing the transmissivity of individual units and the total pressure change and density differences in the system; and, 5) The application of these principles to both shallow and deep flow systems analysis has led to a better understanding of the systems and how they may potentially respond to external influences. (Lantz-PTT)
W86-04215

ELECTRONIC SENSING DEVICES USED FOR IN SITU GROUND WATER MONITORING,
Woodward-Clyde Consultants, Overland Park, KS.
For primary bibliographic entry see Field 7B.
W86-04217

FM RADIOTELEMETRY COUPLED WITH SONIC TRANSDUCERS FOR REMOTE MONITORING OF WATER LEVELS IN DEEP AQUIFERS,
Corps of Engineers, Winchester, VA. Middle East Div.
For primary bibliographic entry see Field 7B.
W86-04218

ANALYSIS OF A CONTAMINATED BEDROCK AQUIFER BY MEANS OF A PACKER AND ATTEMPTS AT REMEDIATION USING A PACKER,
Olin Chemical Group, Charleston, TN.
For primary bibliographic entry see Field 5B.
W86-04220

MICRO COMPUTERS APPLIED TO GROUND WATER MONITORING AND TESTING,
Dames and Moore, Baldwinsville, NY.
L. K. Brannaka, and L. R. Keefe.
Ground Water Monitoring Review, Vol. 6, No. 2, p 135-139, Spring 1986. 3 fig.

Descriptors: *Computers, *Groundwater monitoring, *Aquifers, Piezometry, Data acquisition, Data storage, Pump testing, Porosity.

Documented are systems which have been developed and used for simultaneous monitoring of several wells during aquifer tests, and systems installed for long-term monitoring of piezometric surface fluctuations. Both systems can be contained in a small suitcase or insulated cooler. Specific features of the systems include multiple channel capacity, one-month maintenance period, variable computer controlled reading intervals, magnetic tape data storage, data reduction and analysis capabilities while maintaining monitoring, graphic display of time and measurements, hard copy capability and barometric pressure change corrections. Other applications are examined for the complete control of pumping tests, including pumping rate; in situ permeability tests; monitoring changes; and even strain. The pressure transducer system may also be applied for river gauging and current measurement. (Lantz-PTT)
W86-04222

RELATIONSHIP OF GEOLOGY, PHYSIOGRAPHY, AGRICULTURAL LAND USE, AND GROUND-WATER QUALITY IN SOUTHWEST GEORGIA,
Florida Sinkhole Research Inst., Orlando.
For primary bibliographic entry see Field 5B.
W86-04240

PROGRAM TO CALCULATE AQUIFER TRANSMISSIVITY FROM SPECIFIC-CAPACITY DATA FOR PROGRAMMABLE CALCULATORS,
Geological Survey, Denver, CO. Nuclear Hydrology Program.
For primary bibliographic entry see Field 7C.
W86-04243

SOLUTE-TRANSPORT SIMULATION OF BRACKISH-WATER INTRUSION NEAR BALTIMORE, MARYLAND,
For primary bibliographic entry see Field 5B.
W86-04274

RADIAL INJECTION TRACER EXPERIMENT IN A CONFINED AQUIFER, SCARBOROUGH, ONTARIO, CANADA,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
C. D. Palmer, and R. L. Nadon.
Ground Water GRWAAP, Vol. 24, No. 3, p 322-331, May-June 1986. 16 fig, 2 tab, 13 ref.

Descriptors: *Radial injection, *Tracers, *Confined aquifers, *Scarborough, Ontario, Water storage, Thermal water, Injection wells, Monitoring wells, Mathematical analysis, Resistivity, Chlorides.

A radial injection tracer experiment was conducted to evaluate the feasibility of using a confined aquifer for the storage of chilled and/or heated water for a seasonal thermal energy storage system. Water was injected into the aquifer over a period of four hours at a rate of 22.7 l/s. Injection of the water into the aquifer continued for an additional 15 hours following injection of the salt solution. Samples were collected from a monitoring well located 6.54 m from the injection well. A sampling device was installed prior to the injection experiment to permit the collection of water samples at different elevations within the screened portion of the monitoring well. The samples which were collected at five different elevations at various times, both during and following the salt injection, were analyzed for specific conductance and chloride concentration. The data suggest that the aquifer is inhomogeneous and that the ratio of the hydraulic conductivity to porosity increases from the lowest sampling port to the highest sampling port near the top of the aquifer. A linear relationship was obtained between the time of arrival of the tracer and the apparent resistivity of the formation. This linear relationship was used to calibrate the apparent resistivity log of the injection well to provide a continuous characterization of the vertical variation in the hydraulic conductivity/porosity ratio across the full thickness of the aquifer. Data analysis also suggests that the dispersivity parameter varies linearly with the time of arrival of the tracer. The combination of geophysical logs with tracer experiments may permit detailed characterization of the hydraulic properties of aquifers. (Lantz-PTT)
W86-04276

DIAGNOSTIC HYDROLOGY,
Florida Agricultural and Mechanical Univ., Tallahassee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2A.
W86-04277

CONTAMINANT MOVEMENT UNDER PUMPAGE-RECHARGE CONDITION IN STEADY GROUNDWATER FLOW SYSTEM,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-04278

EVALUATION OF TRANSIENT ELECTROMAGNETIC SOUNDINGS FOR DEEP DETECTION OF CONDUCTIVE FLUIDS,
University of South Florida, Tampa. Dept. of Geology.
M. Stewart, and M. C. Gay.
Ground Water GRWAAP, Vol. 24, No. 3, p 351-356, May-June 1986. 7 fig, 5 ref.

Descriptors: *Electromagnetic waves, *Geophysics, *Aquifer characteristics, *Sounding, *Saline-freshwater interfaces, *Conductivity, Resistivity, Unconfined aquifers, Saline-freshwater interfaces, Karst, Aquifers, Porosity, Chloride, Geohydrology.

Transient electromagnetic sounding methods (TEM) have several advantages over DC resistivity soundings. The primary advantage is that sounding depths several times the receiver-transmitter spacing can be achieved, resulting in less cumbersome field work and more flexible sounding site selection. The TEM method was tested using a commercially available instrument (Geonics EM-37) in the Gulf Springs region of west-central Florida to locate the salt-water interface in the Floridan Aquifer. The Floridan is a thick (200 m), unconfined, karstic, carbonate aquifer within the study area. High annual rainfall and internal drainage create a deep and dynamic interface. Eighty transient soundings were completed in 18 field days. Seventy-one soundings used a square 80 m x 80 m transmitter loop, and the other nine used a 160 m x 160 m coil. The interface was easily detected from a minimum depth of 60 m to its maximum depth of about 140 m. Also a high-resistivity, low-porosity zone was detected at depths ranging from 180 - 250 m. The TEM data compare well with available chloride concentration data. The TEM interface corresponds to chloride values in excess of 200 - 400 mg/l. The sounding curves obtained suggest that with presently available instruments the TEM method is not well-suited for shallow soundings (less than 40 - 50 m). (Lantz-PTT)
W86-04279

SATURATED THICKNESS FOR DROUGHT AND LITIGATION PROTECTION,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W86-04280

GROUND-WATER PROBLEMS IN THE MESOZOIC PAX MOUNTAIN FAULT ZONE,
Clemson Univ., SC. Dept. of Chemistry and Geology.
d. S. Snipes, P. R. Manoogian, M. W. Davis, L. L. Burnett, and J. A. Wylie.
Ground Water GRWAAP, Vol. 24, No. 3, p 375-381, May-June 1986. 3 fig, 3 tab, 16 ref.

Descriptors: *Groundwater potential, *Geohydrology, *Pax Mountain, *Geologic fractures, Igneous rocks, Metamorphic roles, Boreholes, South Carolina, Wells, Clay, Potable water, Turbidity.

The present investigation deals with the hydrological problems encountered in exploring for groundwater in the Pax Mountain Fault zone, which is cut across by Paleozoic igneous and metamorphic rocks. This is the largest known Mesozoic fault in the Carolinas, having a length of more than 75 km and attaining a width of 1 km in places. Subsurface studies of seven wells, which were drilled along the axis of Pax Mountain, South Carolina, show that the composition of the fault rocks is much more complicated than was known before. These rocks consist of angular particles of quartz and feldspar fault breccia enclosed in a kaolinitic clay gouge. They vary greatly in degrees of consolidation and permeability, and these variations were the cause of some serious groundwater problems. Two wells were dry holes because the intergranular spaces of the breccia were clogged with clay and also because most of the joints were filled with secondary minerals. Three wells, which were drilled in more permeable, but poorly consolidated fault rocks, caved in at a depth of about 80 m just when they had encountered large volumes of water. Two of the seven wells produce potable water, but chemical analyses of the groundwater showed that their turbidity values were 6.0 turbidity units (t.u.) and 2.0 t.u., which exceed the limit of 1.0 recommended by the South Carolina Department of Health and Environmental Control. (Lantz-PTT)
W86-04282

ANALYTICAL AND APPROXIMATE SOLUTIONS TO RADIAL DISPERSION FROM AN INJECTION WELL TO A GEOLOGICAL UNIT WITH SIMULTANEOUS DIFFUSION INTO ADJACENT STRATA,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04304

GROUNDWATER MASS TRANSPORT AND EQUILIBRIUM CHEMISTRY MODEL FOR MULTICOMPONENT SYSTEMS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04307

MACROSCOPIC BALANCE EQUATIONS IN SOILS AND AQUIFERS: THE CASE OF SPACE- AND TIME-DEPENDENT INSTRUMENTAL RESPONSE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2G.
W86-04308

TRANSIENT FLOW TO A LARGE-DIAMETER WELL IN AN AQUIFER WITH STORATIVE SEMICONFINING LAYERS,
Geological Survey, Menlo Park, CA.
A. F. Moench.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1121-1131, August 1985. 8 fig, 38 ref, 1 append.

Descriptors: *Mathematical studies, *Aquifers, *Leaky aquifers, *Pumped storage, *Observation wells, Pump wells, Test wells, Transition flow, Aquifer testing, Theoretical analysis.

The Hantush theory of leaky aquifers with storage in the semiconfining layers is combined with large-diameter well theory to produce equations that can be used to analyze pumped-well and observation well data for stratified formations. The equations take into account pumped well storage and a linear resistance to flow at the sand face or well bore skin. Three cases proposed by Hantush are considered. These depend upon whether the upper boundary of the overlying semiconfining layer or the lower boundary of the underlying semiconfining layer are constant head or no-flow boundaries. Laplace transform solutions valid for the complete time domain, are given for each of the three cases for the hydraulic head in the pumped well, the aquifer, and each of the semiconfining layers. Type cures obtained by numerical inversion are used to show the effects of well bore storage, well bore skin, and leakage. Although several dimensionless parameters are involved, these parameters tend to influence the character of different portions of the type curves, suggesting that unique matches are possible. The type curves illustrate that well bore storage in a large-diameter well may completely obliterate effects of leakage derived from compressible storage in semiconfining layers. For the purposes of aquifer testing, it may be possible to reduce the magnitude of well bore storage in a large-diameter well and reveal the presence of leaky semiconfining layers, thus preventing erroneous interpretation of the well test data and incorrect evaluation of the aquifer parameters. (Geiger-PTT)
W86-04309

DISCRIMINATION OF GROUNDWATER SOURCES USING CLUSTER ANALYSIS, MANOVA, CANONICAL ANALYSIS AND DISCRIMINANT ANALYSIS,
Idaho Univ., Moscow. Dept. of Mathematics and Applied Statistics.
R. K. Steinhorst, and R. E. Williams.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1149-1156, August 1985. 5 fig, 3 tab, 12 ref. NRC 02 82 044.

Descriptors: *Multivariate analysis, *Statistical methods, *Groundwater recharge, *Mathematical studies, Mathematical models, Aquifers, Water quality, Chemical properties.

Multivariate statistical analysis of water chemistry variables provides an empirical method of establishing relationships and/or differences among groundwater samples taken spatially or temporally. Careful application of cluster analysis, multivariate analysis of variance, canonical analysis, and discriminant analysis provides insight into possible segregation among groundwater sources or mixing among aquifers and a subsequent test of that conjecture. The present method has been used successfully in an analysis of water sample data from the area of a proposed molybdenum mine in western Colorado, and in differentiating water quality among aquifers in basalt flows and interbeds on the Hanford Reservation in south central Washington. The statistically distinct groups of samples identified by the above methods are supported by structural and geochemical stratification mapping. (Geiger-PTT)
W86-04312

COMPARATIVE STUDY OF GREEN AND AMPT ANALYSIS FOR A FALLING WATER TABLE IN A HOMOGENEOUS SAND PROFILE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
For primary bibliographic entry see Field 2G.
W86-04313

FIELD EXAMPLE OF MEASURING HYDRODYNAMIC DISPERSION IN A SINGLE FRACTURE,
Atomic Energy of Canada Ltd., Ottawa (Ontario).
For primary bibliographic entry see Field 5B.
W86-04314

FREQUENCY DOMAIN APPROACH TO WATER QUALITY MODELING IN GROUNDWATER: THEORY,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5B.
W86-04315

IDENTIFYING HYDRAULICALLY CONDUCTIVE FRACTURES WITH A SLOW- VELOCITY BOREHOLE FLOWMETER,
Geological Survey, Denver, CO. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-04337

EMPIRICAL EQUATIONS OF GROUNDWATER RECHARGE PATTERNS,
Ife Univ. (Nigeria). Dept. of Geography.
E. O. Omorinbola.
Hydrological Sciences -- Journal -- des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 1-11,

March 1986. 4 fig, 3 tab, 18 ref.

Descriptors: *Regolith aquifers, *Groundwater recharge, *Temporal pattern, *Spatial pattern, *Saturated zone, *Rainfall-recharge relationship, *Least Squares method, Nigeria, Middle Osun Valley.

The paper resulted from attempts at fitting empirical equations to describe the patterns of groundwater recharge in the regolith of the Middle Osun Valley in the Nigerian Basement Complex. Equations of both the temporal and spatial patterns were derived empirically by analyzing sample data on saturated zone thickness using a least-squares curvilinear regression technique. The temporal pattern for the study period conforms with the prevailing rainfall regime and is optimally described by fourth-degree polynomial regression equations. the spatial pattern is optimally described by quadratic equations and suggests that an almost uniformly thick annual groundwater recharge zone of about 2.4 m overlies the gross spatial distribution of the saturated zone thickness from the major river channel to the major water divide. The quantitative methodology of this study is universally applicable and could greatly facilitate direct calculation of groundwater recharge and rainfall-recharge correlation if reliable information about relevant parameters of Basement Complex regolith aquifers is available. (Author's Abstract)
W86-04390

CHARACTERIZATION OF DYE TRACER PLUMES: IN SITU FIELD EXPERIMENTS,
Battelle Memorial Inst., Columbus, OH.
T. G. Naymik, and M. E. Sievers.
Ground Water GRWAAP, Vol. 23, No. 6, p 746-752, November-December 1985. 6 fig, 2 tab, 8 ref. EPA Contract No. 806391.

Descriptors: *Dye dispersion, *Dye releases, *Tracers, *Groundwater movement, *In situ tests, Fluorescent dyes, Aquifers, Hydraulic gradient, Wells, Solute transport, Plumes.

In the Spring of 1984, the second in a series of groundwater dye tracer experiments at Sand Ridge State Forest, Illinois, was conducted. Slugs of three different fluorescent dyes (Rhodamine Wt, Amino G Acid, and Lissamine FF) were allowed to migrate under natural hydraulic gradient conditions through a water table aquifer composed of windblown sand overlaying glacial outwash sand and gravel. The plumes in the outwash deposit and in the dune sand were monitored first by a line of sand point wells placed perpendicular to flow at a distance of 10 ft and 5 ft, respectively, from the source wells. A trilevel nest of sand points was then placed in the path of each plume at a greater distance (50 feet from the sources of the deep plumes). The field data suggest that the plume geometry varied with distance from the source. A solute transport model, calibrated to the field data, provided estimates of longitudinal dispersivity (0.10 ft and 0.17 ft for the plumes in the lower unit). The model was then used as a mass accounting system to relate the tracer concentrations detected in monitoring wells to the mass within the plumes. (Lantz-PTT)
W86-04468

ESTIMATING AQUIFER PERMEABILITY FROM FORMATION RESISTIVITY FACTORS,
Woodward-Clyde Consultants, Tallahassee, FL.
T. Kwader.
Ground Water GRWAAP, Vol. 23, No. 6, p 762-766, November-December 1985. 3 fig, 1 tab, 8 ref.

Descriptors: *Aquifer characteristics, *Resistivity, *Permeability, Pumping tests, Flow movement, Saturated soils, Conductance, Boreholes, Aquifers.

A comparison of permeability results for individual producing zones obtained from pumping tests and flowmeter logs showed a good correlation to calculated corresponding formation resistivity factors (F). Unlike formations containing saline water, where the electrical current is conducted through the pore fluid, in fresh water aquifers, the electrical current appears to be conducted along the grain-aqueous interface by surface conductance rather than through the grain or pore fluid. Surface conductance of the current serves to increase the current path length which is recorded as an increase in the measured saturated resistivity. The current path direction and length through the formation is directly related to the shape, diameter, and sorting of the grains, geometric packing arrangement, and degree of matrix cementation. Fortunately, all of these factors that serve to increase the current path also are factors that increase formation permeability. Relative changes in F values can be matched with known permeabilities from aquifer tests and flowmeter logs to quantify the relative productivity of the various zones analyzed. Once this relationship is established, F values can be used to assign relative permeabilities within a single borehole or from borehole to borehole for a given geographical area. This method has been successfully used to estimate permeability in both unconsolidated sands and Tertiary carbonate aquifers in the southeastern Coastal Plain of the United States. (Lantz-PTT)
W86-04469

ENVIRONMENTAL ANALYSIS OF IRON-PRECIPITATING BACTERIA IN GROUND WATER AND WELLS,
Smith (S.A.) Consulting Services, Columbus, OH.
For primary bibliographic entry see Field 5C.
W86-04470

GEOPHYSICAL TECHNIQUES TO DELINEATE SATURATED ALLUVIAL ZONES FOR THE SITING OF HVDC POWER TRANSMISSION RETURN ELECTRODES,
Ertec Western, Inc., Long Beach, CA.
K. Hennon.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 53-57, Fall 1985. 4 7 ref.

Descriptors: *Geophysics, *Saturated alluvial zones, *High-voltage direct current, Electrodes, Geologic formations, Hydrogeology, Groundwater movement, Water quality, Seasonal variations, Resistivity, Soil properties, Model studies.

As high-voltage, direct-current (HVDC) electrical power transmission technology advances, the siting and design of the grounded return electrodes become critical factors. Electrode sites should be chosen where surrounding geologic conditions will not unfavorably channel large earth currents and harmfully affect nearby populations, with an optimum site allowing direct contact between the electrode and a large volume of a stable, low-resistivity material. A saturated alluvial zone between dry surface soils and an underlying crystalline bedrock is an ideal material for containing the current flow from the electrode. A hydrogeologic investigation was conducted to delineate the saturated zone in several alluvial valleys in the southwestern desert region. Regional groundwater flow directions, water quality, and seasonal fluctuations of the water table elevations were determined. The structural shape and topography of the crystalline basement beneath the valleys were interpreted from gravity data. Iterative forward-modeling of the data provided a low-cost means of deducing the volume of the lightweight alluvium. Electrical resistivity surveys were completed to measure the lateral and vertical variations in soil resistivities throughout the valleys. The geophysical data were used to extend the known hydrologic information into areas with no wells. Composite models of the saturated zones in each valley were produced by integrating gravity interpretations with hydrologic and resistivity results. The composite models were used to predict current density in the ground that would be associated with a HVDC electrode. This methodology proved to be a cost-effective means of siting electrodes in a suitable geologic environment that would minimize their detrimental effects. (Lantz-PTT)
W86-04471

GEOPHYSICAL MONITORING OF GROUND WATER CONTAMINATION AROUND WASTE DISPOSAL SITES,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04473

ANALYSIS OF WELL-AQUIFER RESPONSE TO A SLUG TEST,
Princeton Univ., NJ. Dept. of Civil Engineering.
Z. J. Kabala, G. F. Pinder, and P. C. D. Milly.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1433-1436, September 1985. 7 fig, 7 ref.

Descriptors: *Confined aquifer, *Numerical analysis, *Water level, *Mathematical models, Field tests, Fully penetrating wells, Transmissivity, New Brunswick.

The response of a fully penetrating well to a slug test in a confined aquifer can be described by a single differential equation that is valid for any degree of damping. Although an analytical solution is not available, numerical methods are applied readily. The impact of nonlinear terms becomes significant only when the initial water level displacement is a large fraction of the effective water column height. Linear and nonlinear models presented here represent a unified approach to the description of underdamped, critically damped, and overdamped responses of a fully penetrating well in a confined aquifer. It appears that the linear model is sufficiently accurate in all practical cases. Simulations of well responses at Cap Pele and York Point (New Brunswick) demonstrated that the proposed model is capable of reproducing observed field behavior over a broad range of physical responses. The proposed model can serve as a 'refining device' for estimation of transmissivity for overdamped and underdamped well responses. The model is the only reliable tool for estimation of transmissivity from critically damped well responses. (Rochester-PTT)
W86-04541

OPTIMAL CONTROL OF NONLINEAR GROUNDWATER HYDRAULICS: THEORETICAL DEVELOPMENT AND NUMERICAL EXPERIMENTS,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
R. Willis, and B. A. Finney.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1476-1482, October 1985. 5 fig, 5 tab, 23 ref. NSF CEE 83-01230 and INT 82-03044.

Descriptors: *Unconfined aquifers, *Mathematical models, *Finite difference methods, *Optimal pumping pattern, *Planning model, Water demand, Algorithms, Groundwater management, Well hydraulics.

Nonlinear optimization models are presented for the optimal operation of an unconfined aquifer system. The aquifer's response equations were developed using finite difference methods, aquasilinearization, and matrix calculus. The optimization model, which is structured as a discrete time optimal control problem, identifies the optimal pumping pattern necessary to satisfy an exogenous water demand. A quasilinearization optimization algorithm and project Lagrangian methods are used for the solution of the planning models. Several examples are presented to demonstrate the applicability of the solution algorithms for nonlinear groundwater management problems. Groundwater optimization models can be used to identify locally optimal planning, design, or operational problems in nonlinear and nonconvex groundwater systems. (Rochester-PTT)
W86-04544

IMPROVED FORMULAS FOR A DAM PHREATIC SURFACE WITH ACCRETION,
Hochschule der Bundeswehr Muenchen, Neubiberg (Germany, F.R.). Fachbereich Informatik.
U. Hornung, and T. T. Krueger.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1494-1496, October 1985. 5 fig, 2 tab, 13 ref.

Descriptors: *Unconfined aquifer, *Groundwater movement, *Phreatic surface, *Accretion rate,

*Dupuit-Forchheimer theory, Steady flow, Mathematical techniques, Numerical methods.

The free boundary value problem of steady groundwater flow in an unconfined aquifer with accretion is solved by numerical methods in an exemplary situation. New formulas, which improve the results of the commonly-used Dupuit-Forchheimer theory, are given for the dependence of the height of the phreatic surface on the accretion rate. It is shown that simple formulas, which describe the flow of groundwater in a more accurate way than the classical ones, can be derived with the help of modern mathematical techniques. (Author's abstract)
W86-04546

GROUNDWATER CONTAMINATION: A NATIONAL PROBLEM WITH IMPLICATIONS FOR STATE AND LOCAL ENVIRONMENTAL HEALTH PERSONNEL,
Winnebago County Dept. of Public Health, Rockford, IL.
For primary bibliographic entry see Field 5B.
W86-04609

SHALLOW SEISMIC REFRACTION SURVEY OF NEAR-SURFACE GROUND WATER FLOW,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
K. A. Sverdrup.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 80-83, Winter 1986. 4 fig, 1 tab, 11 ref.

Descriptors: *Groundwater movement, *Seismic waves, *Refraction, *Geohydrology, Geological surveys, Monitoring wells, Cores, Illinois.

A shallow seismic refraction survey was conducted as part of a geological and hydrologic investigation of an area adjacent to a proposed coal strip mine in southeastern Illinois. Data obtained from the survey were used to estimate the thickness and geometry of lithologic units within approximately 40 feet of the surface in unconsolidated material overlying bedrock. Data from a nearby groundwater monitoring well and several shallow geologic cores obtained in the survey area indicated the presence of silt-clay unit roughly 10 feet beneath the surface. This unit strongly inhibits the vertical movement of groundwater, resulting in a perched water table. The refraction survey revealed that the morphology of the top of this silt-clay layer is dominated by a narrow, sinuous channel crisscrossing the survey region with an overall downward trend in elevation from the mine site to a small creek roughly 0.25 miles away. Detailed knowledge of the location of this channel was used to identify optimal sites for shallow groundwater monitoring stations. The method proved to be a relatively rapid and cost-efficient means of obtained detailed information concerning the thickness and geometry of the near-surface unconsolidated materials. (Author's abstract)
W86-04658

METHOD FOR SIMULTANEOUS IN SITU MEASUREMENT IN THE VADOSE ZONE OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY AND THE CONDUCTIVITY-PRESSURE HEAD RELATIONSHIP,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W86-04659

CHARACTERIZATION OF SUBSURFACE BACTERIA ASSOCIATED WITH TWO SHALLOW AQUIFERS IN OKLAHOMA,
Florida State Univ., Tallahassee. Dept. of Biological Science.
For primary bibliographic entry see Field 5A.
W86-04664

DISSOLVED IRON IN CHALK GROUNDWATERS FROM NORFOLK, ENGLAND,
Academia Sinica, Beijing (China). Inst. of Technology.
For primary bibliographic entry see Field 2K.
W86-04678

2G. Water In Soils

IRREVERSIBLE SORPTION OF TRACE LEVEL ORGANICS BY GROUND WATER HUMIC SUBSTANCES: A NEW MECHANISM OF TRANSPORT,
Rice Univ., Houston, TX.
For primary bibliographic entry see Field 5B.
W86-04055

DIELECTRIC PROPERTIES OF SATURATED SOILS,
Oklahoma State Univ., Stillwater. Dept. of Physics.
A. Alharthi, and J. Lange.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 173-174, 4 fig. Contract No. CEE-8019278.

Descriptors: *Soil chemistry, *Soil water, *Electrical properties, *Soil physical properties, Soil properties, Soil physics, Chemical analysis, Physical analysis, Porous media.

Characterizing the flow of two fluid components in a porous structure is a complex task. There is a need for new investigative techniques which will determine the time evolution of the flow. This research is directed to developing a time resolved measuring method based on microwave techniques. The porous material is interrogated by a microwave impulse and its response is used to determine the dielectric properties of the composite structure consisting of the soil and saturating fluids. The dielectric constant of the composite material can be related to the saturating fluid content. The object of this investigation is to determine the feasibility of using the dielectric constant of saturated soils to characterize their fluid content. The large difference in the dielectric constant of water and soil components indicates that the composite dielectric constant of the wet soil is strongly dependent on the water content. The initial stages of this investigation focused on three areas. First, a measurement technique to obtain the dielectric constant of saturated soils was established. Second, the relationship between the measured dielectric constant and the volume of saturating fluid was determined. Finally, a variety of fluid saturants were used in the measurements which emphasized the behavior of immiscible organic fluids, particularly those which are not susceptible to any appreciable biological degradation on a long term basis. (Author's abstract)
W86-04087

STOCHASTIC SOIL MOISTURE ESTIMATION AND FORECASTING FOR IRRIGATED FIELDS,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
M. Aboitiz, J. W. Labadie, and D. F. Heermann.
Water Resources Research WRERAO, Vol. 22, No. 2, p 180-190, February 1986. 5 fig, 6 tab, 21 ref. USDA-ARS Project No. 58-9AHZ-9-392.

Descriptors: *Stochastic process, *Soil water, *Forecasting, *Irrigation, Soil moisture deficiency, Evapotranspiration, Colorado, Statistical analysis, Time series analysis.

A methodology is developed for estimating and forecasting soil water depletion and crop evapotranspiration, with explicit consideration of modeling errors and stochastic inputs. The water balance of an irrigated field and a time series model for reference crop evapotranspiration are formulated in state-space form, with soil moisture depletion and reference evapotranspiration as state variables. The Kalman filter is used to generate estimates and forecasts of the state variables, together with statistical information on their associated errors. Model calibration and validity tests are performed with two independent data sets from locations in Colorado. Each set includes several years of reference crop evapotranspiration data calculated from climatological observations, one season of soil moisture measurements, and concurrent irrigation applications. The estimates, forecasts, and error covariance information provided by the model can allow irrigation decisions to be made with explicit consideration of the inherent risks of crop damage or failure under limitations in water, energy, labor, and capital. (Author's abstract)
W86-04172

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL: 1. FUNDAMENTAL CONCEPTS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
W. A. Jury, G. Sposito, and R. E. White.
Water Resources Research WRERAO, Vol. 22, No. 2, p 243-247, February 1986. 1 fig, 24 ref. NSF Grant ECE-8513726.

Descriptors: *Solute transport, *Soil water movement, *Unsaturated flow, *Transfer function model, *Path of pollutants, *Soil water, Physical transformations, Biotransformation, Chemical transformation, Model studies, Law of Mass Balance.

The transfer function model (TFM) of solute transport through unsaturated soil is generalized to describe the movement of a solute that may undergo physical, chemical, or biological transformations as it moves in a soil unit through which the water flow may vary in both space and time. The generalized TFM is shown to be related to the law of mass balance for a solute as interpreted in the context of probability theory. The principal conceptual entity in the TFM is the solute lifetime probability density function. Methodologies for determining this function experimentally are outlined and its relation to the solute travel time density function defined by Jury is shown. Since the generalized TFM is formulated independently of any particular mechanism of solute transport through soil, it is concluded that mechanistic models of solute movement consistent with the law of mass balance are also consistent with the TFM. (see also W86-04178 and W86-04179) (Author's abstract))
W86-04177

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL: 2. ILLUSTRATIVE APPLICATIONS,
Oxford Univ. (England). Soil Science Lab.
R. E. White, J. S. Dyson, and R. A. Haigh.
Water Resources Research WRERAO, Vol. 22, No. 2, p 248-254, February 1986. 5 fig, 3 tab, 16 ref.

Descriptors: *Solute transport, *Soil water movement, *Unsaturated flow, *Path of pollutants, *Transfer function model, *Soil water, Field tests, Groundwater movement, Bromine, Chlorine, Clay, Mathematical analysis, Salts, Bacteria, Flow rates.

The results of field and laboratory studies of solute transport through undisturbed soils following narrow pulse or step-change inputs of soluble or bacteria have been analyzed using the transfer function equation previously developed. The travel time probability density function observed for Br and Cl during unsteady flow in an unsaturated, well structured clay suggested a two-component mechanism comprising fast solute transport through large, interped voids and slow to negligible transport through small, intraped voids. The modal and median travel times varied with soil type, initial water content, and rate of water input. The fractional volume of water that participated in solute transport, theta sub st, was calculated from the rate of water input and the median solute travel time. Values of theta sub st ranged from 14% to nearly 90% of the mean volumetric water contents of the soils. (See also W86-04177 and W86-04179) (Author's abstract)
W86-04178

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL. 3. THE CONVECTION-DISPERSION EQUATION,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, R. E. White, P. R. Darrah, and W. A. Jury.
Water Resources Research WRERAO, Vol. 22, No. 2, p 255-262, February 1986. 4 fig, 2 tab, 30 ref. NSF Grant ECE-8513726.

Descriptors: *Solute transport, *Soil water movement, *Unsaturated flow, *Transfer function model, *Path of pollutants, *Soil water, *Convection-dispersion transport, Groundwater movement, Probability density function, Laplace equation, Flow rates, Convection, Dispersion, Sorption.

The two-component convection-dispersion equation (CDE) model is developed as a special case of the transfer function model (TFM) of solute transport. It is shown that the two-component CDE model can be reformulated as an integral equation for the 'fast' solute component which has the same form and interpretation as the TFM integral equation specialized to (1) steady water flow conditions and (2) solute input or loss restricted to the entrance or exit surface of a soil unit. The travel time probability density function (pdf) for a solute according to the two-component CDE model then is calculated analytically as a Laplace transform. Numerical inversion of the transformed pdf is carried out for several different sets of values of the four adjustable parameters in the CDE model. The effects of convection, dispersion, and linear sorption processes, as well as the influence of the slow solute component, are illustrated by the numerically simulated travel time pdf. It is suggested that the fractional transport volume is the most significant physical parameter in the model in terms on the shape of the travel time pdf. (See also W86-04177 and W86-04178) (Author's abstract)
W86-04179

VARIATION OF INFILTRATION INTO A HOMOGENEOUS SOIL MATRIX CONTAINING A POPULATION OF MACROPORES,
Institute of Hydrology, Wallingford (England).
K. J. Beven, and R. T. Clarke.
Water Resources Research WRERAO, Vol. 22, No. 3, p 383-388, March 1986. 5 fig, 1 tab, 8 ref.

Descriptors: *Infiltration, *Soil matrix, *Hydrologic models, Channels, Soil water, Channel flow, Homogeneity, Soil water movement.

A population of channels penetrates a soil matrix that is otherwise homogeneous. The channels are assumed to be vertical and of circular cross section with constant diameter, but channel depths and radii are allowed to vary over the population. This paper uses a model based on the Green-Ampt assumptions to predict infiltration rates through the walls and bases of channels, resulting in a mathematical description of the way in which infiltration develops in the soil and in which channels fill with water until eventually overland flow is initiated. This model takes account of the fact that there may be a random distribution of channels in space. Expressions for the expected mean and variance of infiltration volumes are derived. Some example results are given and show that below the matrix wetting front, the variance of the change in water content with 30 and 50 channels per square meter may be of the same order as the mean change in water content. The presence of channels can lead to significant increases in predicted channel volumes. (Author's abstract)
W86-04202

CONSTRAINTS ON THE VALIDITY OF EQUILIBRIUM AND FIRST-ORDER KINETIC TRANSPORT MODELS IN STRUCTURED SOILS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
J. C. Parker, and A. J. Valocchi.
Water Resources Research WRERAO, Vol. 22, No. 3, p 399-407, March 1986. 10 fig, 1 tab, 22 ref. EPA Grant No. R-810819-01-0.

Descriptors: *Equilibrium, *Kinetics, *Transport models, *Soil structure, Solute transport, Soil aggregates, Model studies, Mathematical studies.

Solutions are presented for solute transport in a system of spherical aggregates for flux concentrations (C sub f) and for resident concentrations in mobile and immobile zones and in the bulk porous medium, subject to continuous injection or pulse injection of infinitesimal or finite duration. By equating second moments of C sub f versus time for the biocontinuum spherical diffusion model (SD) with those of a monocontinuum model which assumes local equilibrium (LE), an expression for the apparent dispersion coefficient (D sub e) in the LE model in terms of physically meaningful SD model parameters. Constraints on the validity of the LE model are derived by evaluating differences (delta mu sub 3(LE)) between third moments of C sub f versus a temporal variable normalized by the mean residence time. The expression for delta mu sub 3(LE) indicates the manner in which SD-LE model deviation decreases with diminishing aggregate size and immobile zone retardation factor and with increasing mobile zone retardation, mobile pore fraction, and distance from source. For continuous injection delta mu sub 3(LE) = 0.01 generally yields close correspondence between SD and LE models when appropriate D sub e values are used in the latter. For pulse injection of diminishing duration, criteria for the degradation of the SD model to the LE model become more stringent. The SD model is also compared to a first-order kinetic (FO) model to evaluate constraints on the latter in structured soils. Equating second moments of SD and FO models yields an expression for the apparent first-order rate coefficient in terms of SD model parameters. Comparison of third moments yields a criterion delta mu sub 3(FO) for SD-FO model equivalence. A comparison of the error criteria for SD-FO and SD-LE equivalence indicates that the FO model always represents the diffusional kinetics more accurately than the LE model when near a-equilibrium conditions prevail. Surprisingly, for severe nonequilibrium conditions, the LE model may in some instances approximate the SD model results more accurately than the FO model. (Lantz-PTT)
W86-04203

DETERMINING HEAD AND PRESSURE DISTRIBUTION IN LOW TRANSMISSIVITY FORMATIONS AND SOILS,
Gartner Lee Associates Ltd., Markham (Ontario).
For primary bibliographic entry see Field 2F.
W86-04215

TRANSIOMETER: AN ALTERNATIVE METHOD OF SOIL MOISTURE MEASUREMENT IN SLOWLY PERMEABLE SOILS,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
T. P. Trooien, A. R. Bender, and J. H. Bischoff.
Ground Water Monitoring Review, Vol. 6, No. 2, p 99-105, Spring 1986. 5 fig, 3 tab, 16 ref.

Descriptors: *Transiometers, *Soil water, *Soil porosity, *Permeability, Measuring instruments, Data acquisition, Saturated soils, Data interpretation, Voltmeters, Atmospheric pressure.

The union of a piezoresistive pressure transducer and a porous ceramic cup was termed 'transiometer.' The transiometer was constructed from economical and readily available materials. It can be used to be measure soil water potentials in both saturated and unsaturated conditions, and is well suited to continuous monitoring with data acquisition equipment. Transiometer testing was conducted at two sites, one of moderate permeability and the other of slow permeability. The slowly permeable site was instrumented with four replications of the following: (1) transiometers installed at four depths, (2) a transiometer without the ceramic cup, (3) a piezometer, and (4) access tubes for monitoring soil moisture with a neutron probe. The moderately permeable site was instrumented with a transiometer, two piezometers, and an access tube for monitoring with a neutron probe. In saturated conditions the transiometer had a faster response time after installation than the piezometer. Faster response makes the transiometer more desirable for use in slowly permeable soils, especially when monitoring dynamic soil water. Calculated random error of the transiometer measuring system, including a digital voltmeter and a scanner, was typically 0.09 feet , with a maximum calculated to be 0.38 feet. The two most significant components were imprecision of the scanner card and calibration shift. The transiometer was sensitive to atmospheric pressure fluctuations, with sensitivity to atmospheric pressure change increasing with installation depth. (Lantz-PTT)
W86-04216

CONTAMINANT MOVEMENT UNDER PUMPAGE-RECHARGE CONDITION IN STEADY GROUNDWATER FLOW SYSTEM,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 5B.
W86-04278

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE IN SUBSURFACE SOILS,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
For primary bibliographic entry see Field 5C.
W86-04281

MONITORING CHANGES IN TOTAL AND UNFROZEN WATER CONTENT IN SEASONALLY FROZEN SOIL USING TIME DOMAIN REFLECTOMETRY AND NEUTRON MODERATION TECHNIQUES,
Department of Agriculture, Ottawa (Ontario).
H. N. Hayhoe, and W. B. Bailey.
Water Resources Research WRERAO, Vol. 21, No. 8,P 1077-1084, August 1985. p 1077-1084, 8 fig, 1 tab, 17 ref.

Descriptors: *Soil water, *Moisture profiles, *Snowmelt, *Monitoring, *Seasonal variation, Spatial distribution, Soil temperature, Freezing, Neutron activation analysis, Loam.

This paper presents the results of a study utilizing time domain reflectometry and the neutron moderation technique to monitor changes in total water content and unfrozen water content during fall, winter, and spring on a sandy loam site which was maintained snow free to maximize seasonal frost penetration. Soil temperatures were recorded continuously, and meteorological conditions were observed at a nearby climatological station. The procedure of combining the neutron probe and time domain reflectometry employed here showed good potential for augmenting the limited data on soil moisture redistribution in freezing soils under natural conditions. The data indicated the importane of obtaining a representative spatial average of water content measured with time domain reflectometry in order to obtain a good correspondence with neutron probe observations. (Author's abstract)
W86-04305

MACROSCOPIC BALANCE EQUATIONS IN SOILS AND AQUIFERS: THE CASE OF SPACE- AND TIME-DEPENDENT INSTRUMENTAL RESPONSE,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
P. Baveye, and G. Sposito.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1116-1120, August 1985. 23 ref. NSF Grant No. CEE 79-20778.

Descriptors: *Mathematical studies, *Soil water, *Aquifers, *Groundwater movement, *Mathematical equations, Soil porosity, Temporal distribution, Spatial distribution, Neutron activation analysis.

Macroscopic balance equations for mass and linear momentum in soils and aquifers are derived in the relativist concept under the condition that all physical variables are associated with a single instrumental weighting function that depends on both position and time. The resulting balance equations

differ in concept from expressions obtained recently in the representative elementary volume (REV) approach by exhibiting additional terms that depend on the time and space derivatives of the instrumental weighting function. These terms indicate that mass and linear momentum balance at the macroscopic scale are not preserved unless the weighting function has space-time invariance properties over the period and spatial domain of measurement. (Author's abstract)
W86-04308

COMPARATIVE STUDY OF GREEN AND AMPT ANALYSIS FOR A FALLING WATER TABLE IN A HOMOGENEOUS SAND PROFILE,
New South Wales Univ., Kensington (Australia). School of Civil Engineering.
K. K. Watson, and S. A. Awadalla.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1157-1164, August 1985. fig, 7 ref.

Descriptors: *Mathematical studies, *Infiltration, *Water table decline, *Numerical analysis, *Soil porosity, Comparison studies, Sand, Soil water, Soil water table, Water table fluctuations.

Equations are developed for a Green and Ampt type analysis for a falling water table regime in an initially saturated homogeneous profile of porous material both with and without the presence of an applied surface flux of constant magnitude. The predictive capability of these Green and Ampt equations for a homogeneous medium sand is then tested against results obtained from a computer-based numerical analysis of the differential equation describing water movement in unsaturated porous media. Three simulations with different rates of water table fall are described for the zero surface flux case with one of these rates also being used when an applied surface infiltration flux is included in the system. Comparisons with Green and Ampt results are then made for these simulations in terms of the discharge-time relationship, the position of the draining front with time, and the thickness of the draining capillary fringe with time. In certain cases the approximate analysis is shown to agree with the numerical simulations quite satisfactorily while in others, notably those involving a more rapid water table fall, the differences are significant. (Author's abstract)
W86-04313

STEADY STATE INFILTRATION: CONSEQUENCES OF (ALPHA) DEPENDENT ON MOISTURE CONTENT,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
J.-Y. Parlange, and W. L. Hogarth.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1283-1284, August 1985. 1 fig, 8 ref. URG and ARGS F84161771.

Descriptors: *Infiltration, *Mathematical equations, *Soil water, *Clay, *Sand, Saturated flow, Unsaturated flow, Infiltration coefficient, Infiltration rate, Moisture content, Soil porosity, Mathematical studies.

It is shown from the examples of a clay and a sand that the alpha parameter, in the steady state infiltration equation, is usually far from constant over the whole range of moisture content. Thus the linearized form of the steady state infiltration equation does not give, in general, an accurate description of the flow of water in a soil if it has both dry and saturated regions. When alpha is dependent on moisture content, the small limit of alpha may represent either a saturated soil or a soil of low water content. The former is more readily achieved in a coarse-textured soil and the latter in a fine-textured soil. (Author's abstract)
W86-04324

SOIL WATER SAMPLERS IN ION BALANCE STUDIES ON ACIDIC FOREST SOILS,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
For primary bibliographic entry see Field 7B.
W86-04364

NUMERICAL STUDY OF THE EFFECTS OF SOIL SURFACE SHAPE UPON THE SOIL TEMPERATURE AND MOISTURE REGIMES,
Cooperative Inst. for Research in the Atmosphere, Fort Collins, CO.
Y. Mahrer, and R. Avissar.
Soil Science SOSCAK, Vol. 139, No. 6, p 483-490, June 1985. 10 fig, 2 tab, 17 ref.

Descriptors: *Mathematical analysis, *Soil surfaces, *Soil temperature, *Soil water, Model studies, Soil physical properties, Environment, Slopes, Diurnal distribution.

The purpose of the study was to simulate the diurnal variations and the overall trends of soil temperature and moisture regime in differently oriented soil shapes. Developed was a numerical, two-dimensional model to study the effect of soil surface shape (ridge, furrow, flat), produced by different cultivation techniques, on the soil moisture and temperature regimes. To simplify the study of different soil surface shapes, a terrain-following coordinate system was used. Environmental conditions, soil physical characteristics, and the slope and aspect of the surface are considered. Calculated moisture and temperature profiles are compared against observed ones, and the study shows that they are significantly influenced by both slope and aspect. In general, good agreement was obtained between predicted soil temperatures and observations. Predicted trends of moisture contents also agreed well with the observed data. The model results show a significant diurnal effect in volumetric moisture contents up to a depth of 0.1 m. Therefore, future studies will have to be undertaken to acquire additional experimental data to verify the model results. (Lantz-PTT)
W86-04404

NOTE ON THE PHYSICAL CHARACTERISTICS OF LINEAR SOILS,
Ceske Vysoke Uceni Technicke v Praze.
M. Kutilek, T. Vogel, and D. R. Nielsen.
Soil Science SOSCAK, Vol. 139, No. 6, p 497-499, June 1985. 2 tab, 12 ref.

Descriptors: *Linear soils, *Soil physical properties, *Hydraulic conductivity, Mathematical studies, Diffusivity.

The relationship between relative hydraulic conductivity, soil water content, and the soil water characteristic curve, was related to a soil water diffusivity (D) of constant value. The dissimilarity of such so-called linear soils from other soils is manifested by a special relation that exists between the unsaturated hydraulic conductivity and the soil water content, rather than a special relation for their soil water characteristic curves. The derived relationships can be used when the results of numerical methods are tested by analytical procedures. (Lantz-PTT)
W86-04405

CHANGES IN SOIL POROSITY AND SURFACE SHRINKAGE IN A REMOLDED, SALINE CLAY SOIL TREATED WITH COMPOST,
Florence Univ. (Italy). Inst. of Geopedology and Applied Geology.
G. Sartori, G. A. Ferrari, and M. Pagliai.
Soil Science SOSCAK, Vol. 139, No. 6, p 523-530, June 1985. 7 fig, 2 tab, 29 ref.

Descriptors: *Soil porosity, *Saline soils, *Clays, *Compost, Soil aggregates, Pore size, Soil dynamics, Soil absorption capacity, Moisture availability.

Studied were modifications induced in soil porosity and in surface shrinkage in a saline clay soil treated with compost in laboratory trials, and the effects of wetting and drying cycles were tested. Porosity and pore size distribution were measured on thin sections prepared from soil samples by using electrooptical image-analysis (Quantimet 720). Shrinkage was measured on the surface of dried samples using the same apparatus. The application of wetting and drying cycles to the control samples first increased the proportion of pores ranging from 30 micrometers to 1 mm in equivalent pore diameter to a maximum, and then these pores decreased steadily with further wetting and drying cycles. In treated samples the intra-aggregate porosity was higher than in control samples only after the first wetting and drying cycles; then it was always lower and at the end of the experiment it decreased with respect to the beginning. Modifications of pore size distribution were also observed. The total surface shrinkage increased after wetting and drying cycles and in control samples was always higher than in treated samples but, at the end of the experiment, cracks were larger in treated samples. This unusual behavior of soil-compost interactions could be ascribed to the salinity of both soil and compost. (Lantz-PTT)
W86-04406

EVAPOTRANSPIRATION AND SOIL WATER RELATIONSHIPS FOR SPRING WHEAT AND SOYBEAN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2D.
W86-04407

STEADY-STATE EVAPORATION FROM LAYERED SOILS,
Agricultural Coll. of Athens (Greece). Lab. of Agricultural Hydraulics.
A. Poulovassilis, and M. Psychoyou.
Soil Science SOSCAK, Vol. 140, No. 6, p 399-405, December 1985. 6 fig, 13 ref.

Descriptors: *Soil water, *Evaporation, *Layered soils, Pressure head, Water table fluctuations, Soil types, Soil properties.

The paper theoretically examines the shape of the steady-state soil water profile in layered soils, and the effect of layering on the evaporation rate. It is shown that the soil water pressure head gradient (and the hydraulic head gradient) may show a discontinuity at the layer junction. The characteristics of this discontinuity depend on the value of the pressure head prevailing at the junction and the type of layer considered. Further shown is that the relationships between maximum heights Z above the water table, and the constant evaporation rates U maintained for a relatively coarse and for a relatively fine soil, cross each other at an intermediate value of U, with the relationship for the coarse soil lying lower at small U and higher at large U than that for the fine soil. Finally shown is that when at the layer junction, pressure head values prevail, at which the pressure head-hydraulic conductivity relationships for the two layers cross each other. Then the U-Z sub c,f and the U-Z sub f,c relationships (where Z sub c,f and Z sub f,c denote maximum heights in a fine over coarse and a coarse over fine layer sequence, respectively) form an upper and a lower bound of all other relationships for the layered soils, and of those for the uniform materials that may take part in forming the layered profiles. (Lantz-PTT)
W86-04409

VARIATION IN THE QUALITY OF TENSION LYSIMETER SOIL WATER SAMPLES FROM A FINNISH FOREST SOIL,
Finnish Forest Research Inst., Helsinki.
M. R. Starr.
Soil Science SOSCAK, Vol. 140, No. 6, p 453-461, December 1985. 3 fig, 4 tab, 20 ref.

Descriptors: *Soil water, *Lysimeters, *Water quality, *Forest soils, Iron podsol, Hydrogen, Ammonia, Phosphates, Potassium, Calcium, Conductivity.

The paper examines sources of variation in the chemical quality of soil water collected during a 9-wk period (July to September 1981) with six tensionlysimeters installed at a forest harvested site in central Finland. The soil was an iron podsol, and the lysimeters were installed to a depth of 25 cm. Three lysimeters were installed at 2- to 3-m spacings in the center of two plots, some 200 m apart, and were fitted with 6 cm long x 3 cm o.d. sintered glass cups of pore size 10 to 16 micrometers.

Replicate samples, usually five, were drawn regularly each week with each lysimeter, using a tension pressure of ca. 42 kPa. The mean soil water tension at the 15- and 35-cm depths was 4.1 and 3.1 kPa, respectively. Chemical analysis (conductivity and H(+), NH4(+), PO4(3-), and K(+) and Ca(2+) ion concentrations) of the unfiltered samples was completed within 72 hr of collection. The sampling error among replicates was found to decrease in the order: NH4(+), H(+), PO4(3-), K(+) and Ca(2+), conductivity. Significant differences (P=0.05) in lysimeter water quality within the same plot were found for all determinations except PO4(3-). Significant differences among plots were found for all determinations except NH4(+) and PO4(3-). The amount of spatial variation at each sampling date varied, but the differences among lysimeters were consistent throughout, and all six lysimeters showed generally similar trends. The mean lysimeter/rain quality ratios were: conductivity, 1.9; H(+), 1.1; NH4(+), 0.04; PO4(3-), 0.2; K(+), 6.3; and Ca(2+), 29.3. With the exception of conductivity, lysimeter water quality showed no, or only weak rainfall-related dilution effects. Peak concentrations of H(+) and Ca(2+) followed rainfall with extreme concentrations and loads of these ions. (Lantz-PTT)
W86-04410

SATURATED AND UNSATURATED HYDRAULIC CONDUCTIVITY OF SWELLING CLAYS,
Tokyo Univ. (Japan). Faculty of Agriculture.
M. Nakano, Y. Amemiya, and K. Fujii.
Soil Science SOSCAK, Vol. 141, No. 1, p 1-6, January 1986. 8 fig, 16 ref.

Descriptors: *Soil water movement, *Saturated soils, *Unsaturated soils, *Hydraulic conductivity, *Clays, Soil water, Flow discharge, Swelling clays, Infiltration, Bentonite.

The theory of water flow in swelling clays may be developed in a space coordinate system at rest, assuming that the flux of clay particles can be defined by the space gradients of potential responsible for the movement of clay particles, which is related to the gradients of water potential. Within this framework, the hydraulic conductivity of saturated and unsaturated swelling clays is defined and measured, from the water and clay content profiles obtained from infiltration experiments into unsaturated bentonite. As a result, the hydraulic conductivity is found to increase from 0.000001 - 0.1 cm/d when the volumetric water content increases from 0.5 to 0.95 cu cm/cu cm. (Lantz-PTT)
W86-04411

DETERMINATION OF DIFFUSIVITY AND HYDRAULIC CONDUCTIVITY IN SOILS AT LOW WATER CONTENTS FROM NONDESTRUCTIVE TRANSIENT FLOW OBSERVATIONS,
California Univ., Davis. Dept. of Land, Air and Water Resources.
M. E. Grismer, D. B. McWhorter, and A. Klute.
Soil Science SOSCAK, Vol. 141, No. 1, p 10-19, January 1986. 9 fig, 1 tab, 15 ref.

Descriptors: *Soil water movement, *Diffusivity, *Hydraulic conductivity, *Soil water, *Transient flow, Experimental design, Mathematical studies, Gamma radiation, Vapor adsorption, Reproducibility.

Presented is an experimental method that nondestructively, relatively quickly, and reproducibly develops data necessary for finite-difference calculations of liquid-vapor diffusivities for water contents between approximately 1% and any intermediate value of interest. The method relies on determining the temporal and spatial distribution of water content using gamma-attentuation techniques during water absorption into a horizontal column containing oven-dry soil. Diffusivities (and conductivities given the water retention curve) are calculated from the measured water-content distributions using a finite difference form of the continuity equation. The method is successfully applied to soils varying in texture from a fine sand to a clay loam. Vapor adsorption and transport mechanisms are discussed in the context of the liquid-vapor diffusivity function, using experimentally measured vapor adsorption isotherms. Conductivities calculated from results of experiments conducted using thermocouple psychrometers to nondestructively measure suction heads in a clay loam during the flow processes are also presented. (Lantz-PTT)
W86-04412

1984 DROUGHT ON THE CANADIAN PRAIRIES,
Saint Patrick's Coll., Maynooth (Ireland).
J. Sweeney.
Weather WTHRAL, Vol. 10, p 302-3009, October 1985. 6 fig, 20 ref.

Descriptors: *Drought, *Canada, *Prairies, *Soil Water, *Precipitation, Grain crops, Alberta, Saskatchewan, Manitoba, Evapotranspiration.

The 1984 drought in the three Prairie Provinces, Alberta, Saskatchewan, and Manitoba, Canada, is described, including water balance components (soil water, potential evapotranspiration, actual evapotranspiration, and precipitation), the chronology of the drought, short- and long-term perspectives on causes of the drought, and its cost. Precipitation, snow, and barometric pressure during the 1983-1984 period are discussed. Drought on the prairies can stem either from a poor winter snow season or from a failure of summer precipitation; both had a role in the 1984 drought. A relationship between enhanced zonal flow, which promotes drought on the Plains and Prairies, and solar cycles may be a reality, and the 1984 drought may be seen in this context. A figure in excess of $2.5 billion may be attached to the 1984 drought, primarily as a result of drops in production of major grain crops. (Rochester-PTT)
W86-04508

MEASURED AND CREAMS-PREDICTED NITROGEN LOSSES FROM TOMATO AND CORN MANAGEMENT SYSTEMS,
Southeast Kansas Branch Experiment Station, Parsons.
For primary bibliographic entry see Field 5B.
W86-04538

ROLE OF WATER IN SOIL FORMATION,
Vsesoyuznyi Nauchno-Isledovatel'skii Inst. Tabaka i Makhorki, Krasnodar (USSR).
V. K. Uvarov, and A. I. Ionov.
Soviet Soil Science SSSCAE, Vol. 17, No.2, p 1-6, March-April 1985. 1 fig, 16 refs. Translated from Pochvovedeniye, No 2, p 15-20, 1985.

Descriptors: *Soil water, *Soil genesis, *Soil water movement, *Slopes, Caucasus, Soil catena, Elevation, Precipitation, Chernozems, Podzols, Subsurface water.

The role of water in the formation of soils on short slope and on the general slope of the northwest Caucasus is illustrated. The roles of slope, altitude, annual precipitation, and slope aspect in soil development are discussed. With respect to the direction in which the water moves on the general slope of the western Caucasus, soils can be divided into two groups: (1) soils in which the water moves predominantly in a lateral direction and (2) soils in which the water moves in a predominantly vertical direction. To the first group belong the soils of the mountains and the foothills, beginning with the Mountain Meadow soils and ending with the Gray Mountain Forest soils. To the second group belong the soils of the plain at the foot of the mountains: Compact Chernozems and dense leached Chernozems. The most typical soils of the first group are the gray Typical Mountain Forest soils. Almost all of the water in these soils moves as a lateral subsurface flow and only a very small part percolates into the substratum. The typical soils in the second group are the leached Chernozems, in which the lateral flow is almost absent. Podzolization arises in areas where there is a sharp bend in the surface. As a result of decrease in slope in these areas, water movement slows and flooding occurs. (Rochester-PTT)
W86-04550

SOIL FORMATION ON TUFF PARENT MATERIAL IN THE POKAMENYA TUNGUSKA RIVER BASIN,
Akademiya Nauk SSSR, Moscow. Pochvennyi Inst.
N. I. Belousova, I. I. Vasenev, and Y. B. Tsekhanovskaya.
Soviet Soil Science SSSCAE, Vol. 17, No. 2, p 7-17, March-April 1985. 3 fig, 3 tab, 14 ref. Translated from Pochvovedeniye, No 3, p 9-19, 1985.

Descriptors: *Soil genesis, *Sedimentary rocks, *Soil water, *Precipitation, *Leaching, *Soil profiles, *Soil solution, Iron, Slope movements, Temperature, Podzols, Permeability, Seasonal variation.

Podzol formation on basal tuff sedimentary rocks is evaluated from indirect landscape and soil data, direct determinations of permeability and field moisture percentage, and observations carried out on the soil moisture dynamics and penetration of atmospheric precipitation into the soil profile in years differing in amount of soil moisture. The soils studied here are characterized by the following: (1) a leaching regime with an intensive water exchange that ensures the removal of soluble substances from the soil profile, thereby creating the real conditions for the formation of podzolic soils; (2) a seasonally variable water regime that may not arise every year, but results in the segregation of Fe in the A2 horizons typical of texturally differentiated Taiga soils; (3) fall and spring waterlogging of the soil that may cause the temporary disaggregation and makes plastic the substrate in the lower part of the profile, thereby creating the conditions for slope movements, and (4) judging by the temperature, the present sod-podzolic soils are much older than the loamy sod-podzolic soils of the European USSR. (Rochester-PTT)
W86-04551

RELATIONSHIPS BETWEEN THE SWELLING OF SOME SOILS AND SPECIFIC SURFACE CATEGORIES AND THE ENERGETICS OF SOIL MOISTURE,
Akademiya Nauk SSSR, Moscow. Pochvennyi Inst.
P. M. Sapozhnikov.
Soviet Soil Science SSSCAE, Vol. 17, No. 3, p 87-93, May-June 1985. 2 fig, 2 tab, 11 ref. Translated from Pochvovedeniye, No 3, p 40-45, 1985.

Descriptors: *Soil water, *Wetting, *Humas, Soil properties, Podzols, Chernozems.

The relationship between swelling, specific surface categories, and the energy status of soil water was examined in sod-podzolic soils, ordinary chernozems, and red ferralitic soils. External specific surface has the greatest effect on the swelling of sod-podzolic and ferralitic soils, whereas the humus and specific surface (determined by low-temperature nitrogen absorption) have the greatest effect on the swelling of Chernozemic soils. Two stages of swelling, corresponding to the energy states of soil water can be distinguished: intradomain and interdomain. Intradomain swelling corresponds to the interval of potentials from the initial potentials to the first layer of the wetting film. Interdomain swelling corresponds to the interval of potentials from the first layer of the wetting film to the first critical potential, which corresponds to the maximum film moisture. (Rochester-PTT)
W86-04552

DIURNAL VARIATIONS OF SOIL-MOISTURE TENSION,
Moscow State Univ. (USSR). Dept. of Soil Science.
A. D. Voronin, Y. V. Shein, and I. I. Gudima.
Soviet Soil Science SSSCAE, Vol. 17, No. 4, p 85-93, July-August 1985. 4 fig, 12 ref. Translated from Pochvovedeniye, No 6, p 66-74, 1985.

Descriptors: *Soil water, *Temperature, *Evapotranspiration, *Diurnal distribution, Clay loam, Cotton, Alfalfa, Hysteresis, Cultivated lands, Podzols.

Diurnal variations in soil-moisture tension (P sub t) and their causes were conducted on various clay loam soils, either fallow, or under cotton or alfalfa cultivation. Tensiometers with combined water-mercury manometers were employed in sampling. P sub t fluctuates considerably during the day, from -20 to -44 kPa in the surface layers. The amplitude of the fluctuations decreases with depth, reaches maximum values for P sub t from -20 to -40 kPa, and decreases as the soil dries more deeply. The minimum P sub t values are observed at 7-11 pm, and the maximum values at 9-11 am. The diurnal variations of P sub t are produced primarily by evapotranspiration and water inflow from neighboring soil layers. The existence of a diurnal P sub t variation, its dependence on the inflow and outflow of water and, to a lesser extent, on meteorological conditions and soil temperature, elucidates some difficult-to-explain facts, and raises several new problems. The dynamics of P sub t make it difficult to obtain a water-retention curve from field data. Hysteresis also complicates the analysis of field data. (Rochester-PTT)
W86-04553

MODEL OF THE HYSTERESIS OF WATER RETENTION BY SOILS,
Akademiya Nauk SSSR, Moscow. Inst. of Soil Science and Photosynthesis.
R. A. Shcherbakov.
Soviet Soil Science SSSCAE, Vol. 17, No. 4, p 103-111, July-August 1985. 3 fig, 33 ref. Translated from Pochvovedeniye, No. 8, p 54-60, 1985.

Descriptors: *Soil water retention, *Soil water, *Capillary water, *Hysteresis, *Sorption, *Desorption, Mathematical model, Retention capacity.

A mathematical model of capillary hysteresis is proposed that makes it possible to construct intermediate curves from the sorption and desorption curves of soil water retention. The model is based on a description of the relation between the surficial and spatial filling of pores and on the correlation of pore filling with suction pressure. In an example, second order wetting and drying curves are constructed. Experimental and computed curves of water retention by soils (sand, sandy loam, clay, silt loam, and clay loam) showed good agreement, thus verifying the present method for computing intermediate wetting and drying curves. Intermediate curves of higher order can be constructed similarly to second-order curves, making it possible to compute water transport in soils with allowance for hysteretical phenomena. A correlation function of pore filling characterizes the structure of the pore space of soil. (Rochester-PTT)
W86-04554

INTERCEPTION OF SNOW BY THE FOREST CANOPY,
Tennessee Div. of Health Planning, Nashville.
For primary bibliographic entry see Field 2C.
W86-04555

HYDROMORPHIC SOILS WETTED BY GROUNDWATER IN NORTHERN KAZAKHSTAN,
Kazakhskii Gosudarstvennyi Selskokhozyaistvennyi Inst., Alma-Ata (USSR).
V. A. Bobrov, and A. G. Safronov.
Soviet Soil Science SSSCAE, Vol. 17, No. 1, p 11-20, January-February 1986. 2 fig, 5 tab, 10 ref. Translated from Pochvovedeniye, No 2, p 5-14, 1985.

Descriptors: *Soil water, *Soil classification, *Surface water, *Groundwater, *Kazakhstan, Steppes, Plains, Soil profiles.

New large-scale studies, which included boring into main profiles to the groundwater level in soils of Northern Kazakhstan, revealed substantial areas of soils with groundwater close to the surface. The soils of the slightly undulating plains of this area previously were considered to be automorphic. Based on all the currently available data, the authors divide the hydromorphic soils of the steppes (including semihydromorphic into three groups: (1) hydromorphic soils with surface wetting, including (a) surface flowing and (b) surface stagnant; (2) hydromorphic soils wetted by groundwater, including (a) ground-transpiration and (b) ground-hydrodynamic wetting; and (3) hydromorphic soils with mixed wetting, including (a) flowing and (b) stagnant. The genesis of the groundwater lying under these soils requires further study. (Rochester-PTT)
W86-04556

2H. Lakes

MANAGEMENT OF LAKE COMO: A MULTIOBJECTIVE ANALYSIS,
Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
For primary bibliographic entry see Field 6A.
W86-04165

FROM PHYTOPLANKTON TO DETRITUS AND BACTERIA: EFFECTS OF SHORT-TERM NUTRIENT AND FISH PERTURBATIONS IN A EUTROPHIC LAKE,
Oslo Univ. (Norway). Biologisk Inst.
For primary bibliographic entry see Field 5C.
W86-04180

REGULATING FACTORS OF THE CONCENTRATION OF DISSOLVED CARBOHYDRATES IN A CENTRAL WATER COLUMN OF LAKE SUWA, JAPAN,
Yamagata Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-04182

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 1. DYNAMICS OF PRODUCTION AND POPULATION OF THE PHYTOPLANKTON IN DEPENDENCE ON NUTRIENTS (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 1. PRODUCTIONS- UND POPULATIONSDYNAMIK DES PHYTOPLANKTONS IN ABHANGIGKEIT VOM NAHRSTOFFANGEBOT),
Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-04183

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 2. SEASONAL, VERTICAL AND HORIZONTAL DISTRIBUTION OF BACTERIA (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 2. SAISONALE, VERTIKALE UND HORIZONTALE VERTEILUNG DER BAKTERIEN),
Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-04184

UPTAKE OF INORGANIC CARBON AND NITROGEN BY PHYTOPLANKTON DURING THE WINTER MIXING PERIOD IN A FRESHWATER LAKE, LAKE NAKANUMA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
T. Miyazaki, and S. -E. Ichimura.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 409-421, February 1986. 5 fig, 4 tab, 20 ref. Japan Ministry of Education, Science and Culture Grant No. 60540419.

Descriptors: *Absorption, *Inorganic compounds, *Carbon, *Nitrogen, *Phytoplankton, *Lake Nakanuma, Mixing, Light penetration, Opacity, Nitrates, Nitrites, Ammonium, Model studies, Japan.

Assimilation of inorganic carbon and nitrogen into phytoplankton was examined during the winter mixing period in a small, freshwater lake, Lake Nakanuma, Japan. Carbon assimilation in the surface layer (1 m) was larger than that in the deeper layers (4 and 8 m). The difference between the assimilation in the light and that in the dark was large. Ammonium assimilation was largest among inorganic nitrogen examined (ammonium, nitrite and nitrate). Uptake of nitrate and nitrite was almost negligible, compared to that of ammonium. Ammonium assimilation in the dark was slightly smaller than that in the light, the difference between light and dark assimilation of ammonium was not as large as that of carbon. These results are consistent with the model that carbon and nitrogen assimilation into phytoplankton does not necessarily occur simultaneously, and that sorted carbon may be used for assimilation of nitrogen and for synthesis of nitrogen compounds including amino acids, protein and nucleic acids. (Lantz-PTT)
W86-04185

ENERGY FLOW IN THE POPULATIONS OF EUDIAPTOMUS GRACILOIDES AND DAPHNIA GALEATA IN LAKE ESROM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
For primary bibliographic entry see Field 5C.
W86-04189

VERTICAL DISTRIBUTION OF FEEDING AND PARTICLE-SELECTIVE TRANSPORT OF 137CS IN LAKE SEDIMENTS BY LUMBRICULID OLIGOCHAETES,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
For primary bibliographic entry see Field 2J.
W86-04246

EFFECT OF FALL TURNOVER ON TERMINAL CARBON METABOLISM IN LAKE MENDOTA SEDIMENTS,
Wisconsin Univ.-Madison. Dept. of Bacteriology.
T. J. Phelps, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1285-1291, Nov. 1985. 2 fig, 6 tab, 39 ref.

Descriptors: *Carbon Cycle, *Sediment Analysis, *Lake Sediments, *Lake Mendota, Wisconsin, *Bacterial Analysis, Methane Bacteria, Sulfates, Eutrophic Lakes, Seasonal Variation, Methanol, Acetate, Ethanol, Stratification, Carbon Dioxide.

The carbon and electron flow pathways and the bacterial populations responsible for the transformation of H2-CO2, formate, methanol, methylamine, acetate, ethanol, and lactate were examined in eutrophic sediments collected during summer stratification and fall turnover in Lake Mendota, Wisconsin. The rate of methane formation averaged 1.130 micromol of CH4/liter of sediment/day during late-summer stratification versus 433 micromol of CH4/liter sediment/day during the early portion of fall turnover, whereas the rate of sulfate reduction of 280 micromol of sulfate/liter of sediment/day versus 1,840 micromol of sulfate/liter of sediment/day during the same time periods, respectively. The sulfate-reducing population remained constant while the methanogenic population decreased by one to two orders of magnitude during turnover. The acetate concentration increased from 32 to 81 micromol/liter of sediment while the acetate transformation rate constant decreased from 3.22 to 0.71/h, respectively, during stratification versus turnover. Acetate accounted for nearly 100% of total sedimentary methanogenesis during turnover versus 70% during stratification. The fraction 14CO2 produced from all 14C-labeled substrates examined was 10 to 40% higher during fall turnover than during stratification. The addition of Desulfovibrio vulgaris to sulfate-amended sediments greatly enhanced the amount of CO2 produced from either (14C)methanol or (2-14C)acetate, suggesting that H2 consumption by sulfate reducers can alter methanol or acetate transformation by sedimentary methanogens. These data suggest that turnover dynamically alters carbon transformation in eutrophic sediments such that sulfate reduction dominates over methanogenesis principally as a consequence of altering hydrogen metabolism. (Author's abstract)
W86-04253

TRACE METAL DEPOSITION AND MOBILITY IN THE SEDIMENTS OF TWO LAKES NEAR SUDBURY, ONTARIO,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5B.
W86-04349

WATER BALANCE OF LAKE VICTORIA,
Institute of Hydrology, Wallingford (England).
B. S. Piper, D. T. Plinston, and J. V. Sutcliffe.
Hydrological Sciences - Journal - des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 25-37, March 1986. 5 fig, 3 tab, 16 ref.

Descriptors: *Water balance, *Lakes, *Hydrologic budget, *Rain gages, *Stream discharge, *Rainfall-runoff relationship, *Lake Victoria, *Africa, Statistical analysis.

After reviewing lake inflows and the method of calculating lake rainfall from lakeside gauges, the historic lake water balance between 1961 and 1964 was reproduced. The historic sequence of lake levels can be reproduced using relatively simple combinations of the lakeside rainfall records, without the need for adjustment of the rainfall component during periods of lake rise. This rainfall series can be used either with measured tributary inflows of 1956-1978 or with tributary inflows simulated from catchment rainfall over the longer period 1925-1978. The rainfall and tributary inflows, in combination with a reasonable estimate of evaporation, can reproduce the measured lake levels and lake outflows through the water balance in terms of seasonal and long-term variations. This success can be attributed to the fact that a constant set of rain gauges was used, with no scaling constraint on the weighting factors, so that the important rainfall in the northeast was properly represented. A sequence of three years with rainfall above average, but amplifying its variation from the mean, was sufficient to explain what appears to have been an exceptional event when the lake level series is studied in isolation. (Rochester-PTT)
W86-04386

INTERNAL FACTORS CONTROLLING PEATLAND-LAKE ECOSYSTEM DEVELOPMENT,
Wisconsin Univ.-Madison. Center for Limnology.
T. K. Kratz, and C. B. DeWitt.
Ecology ECOLAR, Vol. 67, No. 1, p 100-107, February 1986. 7 fig, 1 tab, 32 ref. NSF Grant Nos. DEB77-14501 and DEB80-12313.

Descriptors: *Peat bogs, *Lakes, *Ecosystems, *Model studies, *Limnology, Stratification, Mat peat, Peat density, Vertical distribution, Growth rates, Radioactive dating, Wisconsin.

To examine nonclimatic factors controlling a small-peatland development, the classical model of peatland development by hypothesizing the existence of three horizontal zones was expanded. Then tested were five predictions derived from the expanded model. Prediction (1): Pete Strata. There are two vertical strata of peat, an upper layer consisting of peat formed in the floating or grounded mat (mat peat) and a lower layer of peat formed in the floating mat, but dropped from the side or bottom of the mat (debris peat). Underlying these strata are lake sediments originating in the water column. Prediction (2): Strata Boundary. Chamaedaphne calculata provides the framework for mat growth, and therefore stems and roots of this plant from the lake edge to the upland. Prediction (3): Strata Thickness. Thickness of mat peat increases as a function of the depth of the original basin and the length of time peat has been accumulating. Prediction (4): Peat Density. The density of peat increases with distance from the lake edge up to a zone in which peat has reached a maximum density and mean density is constant. Prediction (5): Vertical Accumulation Rate. The long-term rate of vertical accumulation (in grams/sq m/yr) decreases with distance from the lake edge. To test these predictions, data were collected on peat stratigraphy, lake-edge vegetation, and peat age and density in Fallison Bog, a 5.5-ha peatland lake system in Northern Wisconsin, and to a lesser extent from 13 other peatlands in the region. Each prediction was confirmed, except that thickness of mat peat appears to be independent of peat accumulation time. The vertical growth rate of the mat was estimated by radiocarbon dating of C. calculata stems. By dating twigs at different locations in the mat, it was estimated that the rate of vertical peat accumulation ranges from 34-75 gm/sq m/yr, depending on location within the peatland. (Lantz-PTT)
W86-04400

DIURNAL MIXED LAYER,
Western Australia Univ., Nedlands. Dept. of Civil Engineering.
J. Imberger.
Limnology and Oceanography LIOCAH, Vol. 30, No. 4, p 737-770, July 1985. 26 fig, 2 tab, 49 ref.

Descriptors: *Wind, *Solar energy, *Mathematical model, *Mixolimnion, *Isotherms, Energy conversion, Upwelling, Monin-Obukhov length, Wellington reservoir, Australia, Diurnal distribution, Limnology.

Fine-scale measurements and temperature gradient microstructure data are used to describe the diurnal energetics of the mixed layer in the Wellington Reservoir, Western Australia. The Wedderburn number (W) ranged from 0.02 at the start of the heating phase to about 10 at the end of the convective period. During the intermediate strong wind period, W remained at about 0.1; the surface wind stress induced a strong tilt of the isotherms at the base of the mixed layer. The ratio of the Monin-Obukhov length to the depth of the mixed layer ranged from about 5.0 during the morning to 0.005 at the end of the convective period. A simple one-dimensional integral mixed layer model was applied to assess the importance of the temporal terms in diurnal simulations and to verify the values of the energy conversion efficiences used in such models. Overall, the model performed extremely well, but the results showed the need to develop paramaterizations for the energetics of billowing induced by large shears across the base of the mixed layer and for the mixing accompanying upwelling. (Rochester-PTT)
W86-04510

SPECIAL CONTRIBUTION, MANAGING THE GREAT LAKES BASIN AS A HOME,
Bundesministerium der Finanzen, Bonn (Germany, F.R.).
W. J. Christie, M. Becker, J. W. Cowden, and J. R. Vallentyne.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 2-17, 1986. 16 ref.

Descriptors: *Great Lakes, *Water management, *Lake basins, Lake morphology, Environmental policy, Ecosystems, Economic impact, Public participation.

The ecosystem approach, a more holistic way to planning, research, and management of the Great Lakes basin, was articulated as a concept in the 1978 Great Lakes Water Quality Agreement. In order to stimulate movement of this concept to a series of implementable actions, and Ecosystem Approach Workshop was held in March 1983. The paper describes the process used to define common cause for a group of fifty-six participants a diverse spectrum of backgrounds. Three generic obstacles to attainment of an ecosystem approach, which emerged from pre-workshop. They were: (1) lack of an holistic perspective, (2) predominance of egosystem thinking, and (3) lack of a preventive approach. The strategy suggested for overcoming the obstacles was identified as 'enlightened self-interest.' The participants proposed 33 initiatives for advancing the ecosystem approach. These initiatives related to improving the acquisition of scientific data, directing institutional change for ecosystem management, improving citizen participation, paying the costs for resources use, education, and public awareness. In order to help implement these initiatives, establishment of an ecosystem approach monitoring group and an improved public information program is recommended. (Author's abstract)
W86-04524

SEASONAL AND SPATIAL DISTRIBUTION OF BACTERIA, CHLOROPHYLL, AND NUTRIENTS IN NEARSHORE LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
R. Moll, and M. Brahce.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 52-62, 1986. 5 fig, 4 tab, 46 ref.

Descriptors: *Lake Michigan, *Bacteria, *Chlorophyll, *Nutrients, *Spatial distribution, Seasonal distribution, Biomass, Grand River, Population dynamics, Ecological effects, Lake morphology, Glucose, Biological analysis.

Bacterial abundances and metabolic activity were related to chlorophyll concentrations, nutrient concentrations, and the physical environment in the vicinity of the Grand River discharge into Lake Michigan. The results show that bacteria and phytoplankton displayed almost opposite seasonal and spatial distributions. Bacterial abundances were at their annual high in the late summer and early fall when chlorophyll concentrations and primary productivity were at a seasonal low and nutrient concentrations were at their annual nadir. These results indicate that bacterial populations were not highly stimulated by the presence of algae or algal extracellular excretions. However, a complete separation of bacterial and algal dynamics was difficult because of the ecological overlap between microalgae (less than 3 micro in diameter) and bacterioplankton. Analysis of bacterial abundance, chlorophyll concentration, and glucose uptake by size fractions showed that Lake Michigan has an abundant crop of microalgae. These microalgae were difficult to separate from the bacterioplankton. The glucose uptake data by size class suggested a significant portion of dark heterotrophy was conducted by algae. (Author's abstract)
W86-04526

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN NON-MIGRATORY FISH FROM THE NIAGARA RIVER AREA AND TRIBUTARIES TO LAKE ONTARIO,
Indiana Univ. at Bloomington. Dept. of Chemistry.
R. Jaffe, and R. A. Hites.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 63-71, 1986. 3 fig, 3 tab, 18 ref. EPA Grant No. R-808961/.

Descriptors: *Organic compounds, *Halogens, *Fish, *Niagara River, *Lake Ontario, Methane, Gas chromatography, Mass spectrometry, Water pollution effects, Bromine, Industrial wastewater, Pesticides, Chlorinated hydrocarbons.

Non-migratory fish from the mouths of tributaries to Lake Optario and from the Niagara River and its tributaries were analyzed for anthropogenic organic compounds by methane enhanced, negative ion, gas chromatographic mass spectrometry. The results indicate that non-migratory fish, sampled at distances of up to 300 km from Niagara Falls, New York, accumulate pollutants originating at a particular hazardous waste site in that city. Several brominated aromatic compounds that apparently come from Rochester, New York, were also identified. A variety of chlorinated pesticides and compounds of industrial origin were found. (Author's abstract)
W86-04527

RELATIONSHIPS BETWEEN CHLORINATED HYDROCARBON CONCENTRATIONS AND REARING MORTALITY OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EGGS FROM LAKE MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-04528

EVALUATION OF MANAGEMENT ASPECTS OF A HYPERTROPHIC AFRICAN IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South

Africa).
For primary bibliographic entry see Field 5G.
W86-04569

SIMULATION OF WATER-BLOOM IN A EUTROPHIC LAKE - IV: MODELING THE VERTICAL MIGRATION IN A POPULATION OF MICROCYSTIS AERUGINOSA,
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5C.
W86-04579

USE OF ENHANCED LANDSAT IMAGERY FOR MAPPING LAKE DEPTH,
Winnipeg Univ. (Manitoba). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04603

MODEL FOR SEDIMENT OXYGEN DEMAND IN LAKES,
Beak Consultants Ltd., Mississauga (Ontario).
For primary bibliographic entry see Field 5B.
W86-04639

RESPONSE OF PHOTOSYNTHETIC PARAMETERS TO ENVIRONMENTAL FACTORS IN SIGGEFORASJON, SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
For primary bibliographic entry see Field 5C.
W86-04647

MACROPHYTE DECOMPOSITION IN TWO TROPICAL LAKES,
Fisheries Research Inst., Szarvas (Hungary).
For primary bibliographic entry see Field 5C.
W86-04649

ECOLOGICAL ZOOGEOGRAPHY OF PALAEMONETES ANTENNARIUS (CRUSTACEA, DECAPODA),
Innsbruck Univ. (Austria). Inst. fuer Zoologie.
G. J. Dalla Via.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 251-262, April 1986. 3 fig, 3 tab, 35 ref. Osterreichische Nationalbank Project No. 1208.

Descriptors: *Shrimp, *Physiological ecology, *Palaemonetes antennarius, Ecological distribution, Temperature effects, Hydrogen ion concentration, Sodium, Calcium, Brackish water, Salinity, Lakes, Lagoons, Rivers, Italy.

The distribution pattern of the fresh and brackish water shrimp Palaemonetes antennarius, shows specific ecological and physiological requirements. These are discussed and reviewed for the species found in Italian lakes, lagoons and rivers. Water temperature influences the occurence of the shrimps, with a temperature level above 18-20 C which continues for at least 3-4 months, necessary. Palaemonetes antennarius occurs only in water with pH values above 8.0. The ion requirements of the shrimp are also very specific; in fresh water, the critical Na(+) concentration lies between 0.125 and 0.183 mM Na(+)/l at 0.8 mM Ca(++)/l. Below these levels the mortality rate increases. In 4% brackish water, the critical Ca(++) level drops to 0.09 mM Ca(++)/l. In fresh water as well as in brackish water a high Na(+) concentration can compensate for a Ca(++) concentration that is lower than required by the shrimps. The upper limit of the tolerable salinity range of Palaemonetes antennarius is around 20%. The highest survival rate of the species in brackish water is between 3-5%. (Lantz-PTT)
W86-04650

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES: 4. LINDANE (GAMMA-HEXACHLOROCYCLOHEXANE),
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5C.
W86-04651

MICROBIAL DECOMPOSITION OF CELLULOSE IN ACIDIFYING LAKES OF SOUTH-CENTRAL ONTARIO,
Toronto Univ. (Ontario). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W86-04672

INCIDENCE OF VIBRIO CHOLERAE AND RELATED VIBRIOS IN A COASTAL LAGOON AND SEAWATER INFLUENCED BY LAKE DISCHARGES ALONG AN ANNUAL CYCLE,
Valencia Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W86-04674

MODEL FOR THE DISTRIBUTION OF SULFATE REDUCTION AND METHANOGENESIS IN FRESHWATER SEDIMENTS,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
D. R. Lovley, and M. J. Klug.
Geochimica et Cosmochimica Acta GCACAK, Vol. 50, No. 1, p11-18, January 1986. 4 fig, 1 tab, 70 ref. NSF grant DEB 81-09994.

Descriptors: *Mathematical models, *Lake sediments, *Methane bacteria, *Sulfates, Acetate, Microorganisms, Sediments, Bacterial physiology.

A model based on the in situ physiological characteristics of methanogens and sulfate reducers was developed to describe the distribution of methanogenesis and sulfate reduction in freshwater sediments. The model predicted the relative importance of methane production and sulfate reduction in lakes of various trophic status and generated profiles of sulfate, acetate, methanogenesis, and sulfate reduction comparable to the profiles that are expected based on field studies. The model indicated that at sulfate concentrations 30 micromolar a sulfate-reducing zone develops because sulfate reducers maintain acetate concentrations too low for methanogens to grow. At lower sulfate concentrations a methanogenic zone develops because the dual limitations of low sulfate concentrations and acetate consumption by methanogens prevents sulfate reducers from growing. The model and a compilation of previously published field data indicate that, within the reported range of sulfate concentrations (0-280 micromolar) the relative importance of methanogenesis and sulfate reduction in freshwater sediments is primarily dependent upon the rates of organic matter decomposition. (Peters-PTT)
W86-04680

2I. Water In Plants

GAMMA RAY ATTENUATION STUDIES OF INTERCEPTION FROM SITKA SPRUCE: SOME EVIDENCE FOR AN ADDITIONAL TRANSPORT MECHANISM,
Institute of Hydrology, Wallingford (England).
I. R. Calder, and I. R. Wright.
Water Resources Research WRERAO, Vol. 22, No. 3, p 409-417, March 1986. 6 fig, 1 tab, 48 ref.

Descriptors: *Interception, *Gamma radiation, *Sitka spruce, Plant water potential, Water loss, Canopy, Water storage, Wales, Scotland, Water vapor.

Various forest canopy characteristics of stands of Sitka spruce (Picea sitchensis (Bong.) Carr.), including canopy density, the aerodynamic resistance to the transfer of water vapor, and the rates of change of drainage and evaporation of water with respect to canopy storage, were investigated using direct measurements of canopy mass and water storage. The measurements, made at sites located in Wales and Scotland, utilized the attenuation of a horizontal beam of gamma rays which was arranged to scan through the canopy at different levels. The aerodynamic resistance to the transport of water vapor from the canopy to a reference level 5 m above mean tree height was found to be consistent with the value of 3.5 s/m, determined from earlier modeling studies. This value is, however, lower and shows less wind speed dependence than would be expected from conventional formulae which are based on eddy diffusion theory and tree height. The possibility of explaining these discrepancies in terms of an additional transport mechanism involving large-scale eddies is discussed. (Author's abstract)
W86-04204

EVAPOTRANSPIRATION AND SOIL WATER RELATIONSHIPS FOR SPRING WHEAT AND SOYBEAN,
North Dakota State Univ., Fargo. Dept. of Soil Science.
For primary bibliographic entry see Field 2D.
W86-04407

WATER-LIMITED EQUILIBRIUM OF SAVANNA VEGETATION SYSTEMS,
Massachusetts Inst. of Tech., Cambridge.
P. S. Eagleson, and R. I. Segarra.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1483-1493, October 1985. 7 fig, 3 tab, 40 ref, NSF ATM-8114723.

Descriptors: *Mathematical models, *Hydrologic budget, *Evapotranspiration, *Ecological optimality hypotheses, *Climates, *Plant populations, Trees, Grass, Vegetation canopy, Vegetation density, Sudan, South Africa.

The average annual water balance of savanna vegetation systems is modeled as an interactive competition between trees and grass for water and energy. Ecological optimality hypotheses are introduced that allow specification of the woodland canopy density, the grass canopy density, and the plant (water use) coefficients of both tree and grass under conditions of natural equilibrium. Only one tree-grass equilibrium state was found; it agreed well with the observed state of savanna in Sudan and the Transvaal (South Africa). This state is stable with respect to perturbations of vegetation canopy density, but is metastable with respect to shifts in climate. Two other equilibrium states exist as vegetation monocultures, i.e., grassland and forest, but both are shown to be unstable with respect to perturbations in vegetation density. (Author's abstract)
W86-04545

ECOLOGY OF ACHENE DIMORPHISM IN HETEROTHECA LATIFOLIA. III. CONSEQUENCES OF VARIED WATER AVAILABILITY,
Arizona Univ., Tucson. Dept. of Ecology and Evolutionary Biology.
D. L. Venable.
Journal of Ecology JECOAB, Vol. 73, No. 3, p 757-763, November 1985. 2 fig, 1 tab, 23 ref.

Descriptors: *Drought, *Water shortage, *Germination, *Plant growth, *Available water, Water deficit, Competing use, Water stress, Weeds, Biomass, Heterotheca latifolia, Athenes.

The relative success of plants derived from the ray and disc achenes of Heterotheca latifolia when in competition and potentially short of water was examined. The number of living plants was counted at various times during the growth of pure and mixed sowings with regular watering, and mixed sowings with droughts beginning and ending at various times. Disc achenes proved more successful than ray achenes when a plentiful water supply resulted in a high overall biomass and density at the end of the experiment. The inferior performance of ray achenes is attributed to lower embryo provisioning, lower and later germination, and suppression by the early-germinating disc achenes. Ray achenes were more successful than disc achenes when water was scarce and overall biomass and density were low at the end of the experiment. Their superior performance resulted from escaping the water shortage by dormancy. While the disc achene strategy resulted in a higher mean performance across treatments, the ray

achene strategy exhibited lower variance in performance. This result is discussed in terms of fitness in variable environments. (Geiger-PTT)
W86-04618

EFFECTS OF O3 AND ACIDIC RAIN ON PHOTOSYNTHESIS AND GROWTH IN SUGAR MAPLE AND NORTHERN RED OAK SEEDLINGS,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
For primary bibliographic entry see Field 5C.
W86-04660

WATER USE IN WINTER WHEAT AS INFLUENCED BY CEPHALOSPORIUM GRAMINEUM,
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
J. M. Martin, D. E. Mathre, and R. H. Johnston.
Crop Science CRPSAY, Vol. 26, No. 1, p 14-20, January-February 1986. 5 fig, 2 tab, 15 ref.

Descriptors: *Winter wheat, *Soil-water-plant relationships, *Plant pathology, *Cephalosporium gramineum, Water use, Soil water depletion, Grain crops, Bozeman, Montana.

Cephalosporium stripe disease of winter wheat (Triticum aestivum L.) is caused by the soil borne fungus Cephalosporium gramineum. The effect of C. gramineum on root activity and subsequent soil water depletion is unknown. Our objective was to measure water use and soil water depletion patterns for six winter wheat genotypes with differing reactions to C. gramineum, under disease and non-disease conditions. Six winter wheat genotypes, 'arias', 'Widridge', 'Redwin', 'Lenore', MT 7579, and MT 7811 were evaluated for grain yield in replicated control and inoculated plots in 1982 and 1983 near Bozeman, MT, of an Amsterdam silt loam (fine silty mixed family of Haploborolls). Soil water was measured in each plot at 15-cm depth increments to 145-cm with a neutron moisture meter. Soil water measurements were taken at roughly weekly intervals commencing in early May and continuing until harvest in early August. C. gramineum reduced grain yield, water use, and water use efficiency in both years but to a greater extent in 1982 than in 1983. Lenore proved least susceptible and Marias and MT 7811 were most susceptible as measured by reduction in grain yield, water use, and water use efficiency when averaged over both years. Genotypes differed in rate of water use in both years in the presence of the disease, but differences among genotypes were detected only in 1982 in the non-disease situation. Infection by C. gramineum affected water depletion patterns least in Lenore and Winridge, and most in Marias and MT 7811. Genotype x time and genotype x depth interactions were such that relative differences among genotypes were amplified with increasing time and depth. C. gramineum affected soil water extraction throughout the soil profile. Reduction in water extraction may be due to reduced root activity and/or reduced demand for water by infected plants. (Lantz-PTT)
W86-04667

2J. Erosion and Sedimentation

SEDIMENTATION PROBLEMS IN RIVER BASINS.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
UNESCO: Paris, France, 1982. Edited by W. R. White. 152 p, 92 fig, 4 tab, 178 ref, 1 append.

Descriptors: *Erosion, *Erosion control, *Sediment transport, *River basins, *Environmental effects, Sedimentation, Land use, Agriculture, Grazing, Urbanization, Construction, Channels, Weathering, Vegetation, Remote sensing, Watersheds, Model studies, Mathematical models, Forest hydrology, Hydrology, Rivers, Hydraulic structures, Dams, Reservoirs, Banks.

This report has several objectives: (1) to define the effects of man's activities (land use, agriculture, forestry, grazing, mining, construction, urban development, and hydraulic structures) on erosion and sedimentation processes in river basins, (2) to describe the state of knowledge of the cause-effect relationships between plant cover, surface runoff, sediment production and deposition, (3) to inform about amelioration of existing sedimentary conditions, and (4) to describe methods for estimating and predicting changes in erosion and sedimentation processes following manmade changes in watersheds and river channels. Data can be acquired by review of existing data, ground inspection, aerial photography, and remote sensing. Predictive methods include empirical methods, calculation methods, and modeling (mathematical and scale). Control techniques in river basins are divided into agrotechnical measures, forest reclamation, and hydrotechnical measures. Control techniques in the water courses may involve bank protection, flow retardation, flow deflection, and hydraulic structures. Several case studies are presented: sediment study of a wet tropical area of Puerto Rico, problems related to creation of a lake in a semi-arid region of Tanzania, use of a mathematical model to simulate long-term changes in bed levels in estuaries, use of a scale model to study problems associated with dam construction, and quantification of soil erosion caused by storms in a semi-arid region. (Cassar - PTT)
W86-03973

PERSISTENCE IN THE SIZE DISTRIBUTION OF SURFICIAL BED MATERIAL DURING AN EXTREME SNOWMELT FLOOD,
Geological Survey, Denver, CO.
E. D. Andrews, and D. C. Erman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 191-197, February 1986. 3 fig, 80 ref. Research Grant T3770171.

Descriptors: *Maximum likelihood method, *Sediment transport, *Bed load, *Sediment load, *Floods, Statistical analysis, Inverse problem, Hydraulic properties, Regression analysis, Transient conditions, Steady-state conditions.

Sagehen Creek is a small, gravel bed stream in the Sierra Nevada of California. The reach studied has a single-thread, meandering channel with alluvial bed and banks. Surficial bed material sampled throughout a 160-m-long reach has a median diameter of 58 mm. The underlying subsurface bed material is appreciably finer and has median diameter of 30 mm. The bank-full discharge is approximately 2.0 cu m/s, and has been equaled or exceeded on an average of 12.1 days per year during the period of continuous gage operation, water years 1953-1983. Snowmelt runoff in the spring of 1983 was the longest period of sustained, high flows that has occurred in the past 30 years. Bed load transport rates were sampled daily at the peak of the snowmelt flood, May 30 to June 12, 1983. Whole-channel bedload transport rates varied between 0.012 and 0.10 kg/s. An estimated 5800 kg of material larger than 45 mm was transported past the sampling cross section between May 30 and June 12, 1983. These measurements show that a significant quantity of material involving a majority of the particle sizes present in the streambed surface was transported during the period of sustained, large discharges. The size distribution of surficial bed material immediately upstream of the bedload sampling cross section was measured on June 6 near the flood peak and again on July 12 after the flood had subsided. In spite of large differences in discharge and bedload transport the size distributions of particle sizes in the surficial bed material that is present in Sagehen Creek during small discharges also was in place and unchanged during a sustained period of very large discharges. Bedload sampling and measurements of trace-particle movement indicate that only a few particles, though involving nearly all available sizes, were entrained at any instant by even the peak flood flows. (Author's abstract)
W86-04173

ROLE OF COAGULATION IN THE KINETICS OF SEDIMENTATION,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5D.
W86-04229

VERTICAL DISTRIBUTION OF FEEDING AND PARTICLE-SELECTIVE TRANSPORT OF 137CS IN LAKE SEDIMENTS BY LUMBRICULID OLIGOCHAETES,
Wisconsin Univ.-Milwaukee. Center for Great Lakes Studies.
J. R. Krezoski, and J. A. Robbins.
Journal of Geophysical Research, Vol. 90, No. C6, p 11,999-12,006, November 20, 1985. 5 fig, 1 tab, 31 ref. OCE-7825680.

Descriptors: *Lake sediments, *Deposit feeding species, *Tracers, *Sediment redistribution, *Cesium radioisotopes, Sediment-water interfaces, Bottom sediments, Sedimentation.

Two replicate microcosms of rectangular cross section (3x5 cm) containing evenly spaced (1 cm) thin layers (0.5 mm) of sediment labeled with gamma-emitting 137Cs were inoculated with the lumbriculid Stylodrilus heringianus at a density of 7.9 x 10000/sq m (10 C). The subsequent amount of tracer lost from each layer as well as the downward movement of the layers were determined by periodically scanning the length of the cells with a well-collimated gamma detector system. During the course of the 600-hour experiment, 137-Cs activities decreased only in layers between 0 and 6 cm depth. These decreases were accompanied by the appearance of a new layer at the sediment surface. Between 80 and 90% of the activity lost from the underlying layers appeared in the emergent surface peak, thus indicating that subsurface defecation is a minor aspect of conveyor belt transport. Decreases in 137-Cs activity within layers were consistent with first-order kinetics with a maximum loss rate of about 0.08%/hr. The vertical distribution of the rate constant was very nearly Gaussian with the maximum at 3.3 cm and a spread (SD) of 1.4 cm. The rate of layer burial decreased monotonically but nonlinearly with sediment depth from an extrapolated surface value of about 1.8 x 0.01 mm/hr. A model based on conservation of mass was developed which relates the tracer feeding distribution to the velocity distribution assuming that the distribution of mass removed through feeding was proportional to the amount of tracer removed. The model takes rigorous account of depth-dependent porosity and provides an excellent description of the velocity distributions if the transfer of 137-Cs is taken to be 1.67 times the mass transfer rate. This factor, termed the feeding selectivity factor, is attributed to the selection of fine particles by worms and is important in models describing trace and contaminant diagenesis in sediments reworked by conveyor belt species. (Author's abstract)
W86-04246

DISSOLVED AND SUSPENDED MATTER TRANSPORTED BY THE GIROU RIVER (FRANCE): MECHANICAL AND CHEMICAL EROSION RATES IN A CALCAREOUS MOLASSE BASIN,
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
J.-L. Probst.
Hydrological Sciences - Journal - des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 61-79, March 1986. 14 fig, 4 tab, 52 ref.

Descriptors: *Dissolved load, *Suspended load, *Girou River, *France, *Erosion rates, *Calcareous soils, Temperate region, Geologic erosion, Runoff, Mechanical erosion, Chemical erosion, Simple mixing model, Fluvial transport, Sediment yield, Calcium, Biocarbonate, Weathering, Storms.

The mean mechanical and chemical erosion rates of the Girou basin are calculated from the amount of suspended and dissolved material transported by the river. The chemical and mineralogical characteristics of the river load and its behavior are studied during the water year 1980-1981. The origins of the major compounds in the drainage basin

were determined and the contribution of mechanical and chemical erosion to the fluvial transport of each compound were calculated. Calcium and bicarbonate represent about 80% of the total dissolved load, and carbonate dissolution is responsible for 93% of the chemical weathering processes, whereas rock weathering accounts for only 61% of the dissolved material carried by the river. The suspended and dissolved concentrations in the river result from a hydrological and geochemical mixing of runoff from different sources. Suspended material is exported mainly by surface runoff during storm periods. A simple mixing model suggests that the suspended sediment concentration of surface runoff may be assumed to have a constant value of 0.5 g/liter. The Girou suspended sediments closely reflect the nature of soil materials in the temperate regions. (Rochester-PTT)
W86-04387

SUSPENDED SEDIMENT PRODUCTION IN A SUBURBAN TROPICAL BASIN (LUBUMBASHI, ZAIRE),
Ghent Rijksuniversiteit (Belgium).
M. Lootens, and S. Lumbu.
Hydrological Sciences -- Journal -- des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 39-49, March 1986. 4 fig, 3 tab, 29 ref.

Descriptors: *Runoff, *Suspended sediment yield, *Suburban areas, *Tropic zone, *Suspended load, *Floods, Seasonality, River Lubwe, Zaire, Rating Curve technique.

A study of suspended sediment transport in the 8.5 sq km River Lubwe catchment was carried out during the wet season 1983-1984. The suspended sediment yield was estimated using the suspended-sediment rating curve technique and detailed observations of 10 runoff events. The River Lubwe is characterized by periodic high magnitude floods, during which the bulk of the load is transported. The total suspended load for the hydrologic year 1983-1984 is estimated at 108 t, representing a sediment yield of 12.7 t per sq km per yr. (Author's Abstract)
W86-04392

GEOCHEMISTRY OF SUSPENDED PARTICULATE MATTER IN TWO NATURAL SEDIMENTATION BASINS OF THE RIVER RHINE,
Technische Hogeschool Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
For primary bibliographic entry see Field 5B.
W86-04547

2K. Chemical Processes

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICO-CHEMICAL DATA AND MICROSCOPICAL OBSERVATIONS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
G. G. Leppard, J. Buffle, and R. Baudat.
Water Research WATRAG, Vol. 20, No. 2, p 185-196, February 1986. 9 fig, 1 tab, 54 ref.

Descriptors: *Aggregates, *Fulvic acids, *Soil organic matter, *Water analysis, *Organic matter, Electron microscopy, Ultrafiltration.

The size and aggreggation properties of water fulvic acids of pedogenic origin (the pedogenic refractory organic matter of PROM) is discussed on the basis of: (1) physico-chemical data (molecular weight, diffusion coefficient, molecular size both in solution and while adsorbed at air-water and mercury-water interfaces); and (2) photomicrographic data using transmission electron microscopy, or TEM, applied to ultrathin sections of embedded PROM. The usefulness of combining these two types of technologies is demonstrated. The former indicates that aggregation occurs at PROM concentrations >200 mg/l and that the size of dissolved non-aggregated molecules is close to 1 nanometer. The size of molecules adsorbed at some interfaces is smaller, possibly as a result of dehydration. Using TEM, only particles with a size >2-3 nanometer are clearly resolved, a result which may be due to (a) the limited resolution of the TEM technique employed and/or (b) possible aggtregation processes which occur during the preparation of samples. Microscopical observations show that most of the PROM fraction is composed of 3 nanometer granules, either isolated or aggregated together into much larger entities. The granules are similar to those observed by others studying soil fulvic acids. The aggregates must be loose ones, as they can pass ultrafiltration membranes, even when the aggregate size is much larger than the pore size. An integrated interpretation of the results from both types of technologies suggests that, in fresh surface waters, PROM can form a continuum of aggregated particles with widely varying size, in rather fast equilibrium. At surfaces, dehydration may occur, making the aggregation a less readily reversible process. (Author's abstract)
W86-04125

SCAVENGING OF AIRBORNE POLYCYCLIC AROMATIC HYDROCARBONS BY RAIN,
Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands). Lab. for Ecology, Water and Drinking Water.
For primary bibliographic entry see Field 5B.
W86-04135

CONSIDERATIONS ABOUT WATER MINERALIZATION OF SOME MOZAMBICAN RIVERS,
Direccao Nactional de Aq
For primary bibliographic entry see Field 2E.
W86-04151

ORIGIN AND DISTRIBUTION OF SULFATE IN A FRACTURED TILL IN SOUTHERN ALBERTA, CANADA,
Department of Agriculture, Lethbridge (Alberta). Groundwater Section.
M. J. Hendry, J. A. Cherry, and E. I. Wallick.
Water Resources Research WRERAO, Vol. 22, No. 1, p 45-61, January 1986. 12 fig, 5 tab, 40 ref.

Descriptors: *Sulfates, *History, *Alberta, *Canada, Weathering, Sulfur, Groundwater pollution, Path of pollutants, Calcium, Fluctuations, Groundwater movement, Distribution patterns.

Glacial till in a 22 sq km area of the Interior Plains Region of southern Alberta, Canada consists of an upper brown gypsiferous weathered zone (up to 20 m thick) and a lower discontinuous grey non-weathered zone (up to 25 m thick). Although the total sulfur content of the two till zones is the same (0.34%), the mean total sulfate content of the weathered till (4.0 mg/g) exceeds that of the non-weathered till (0.8 mg/g). Similarities suggest that all SO4(2) in the nonweathered till and 20% of the sulfate in the weathered till was derived from sulfate-rich bedrock fragments incorporated in the till during deposition. Laboratory experiments and delta-18 O and delta-34 S analyses of total SO4(2) and the sulfur forms in the two zones show that the majority of the sulfate in the weathered till was derived from the oxidation of organic S at some time after the till was deposited. Mass balance and flux calculations indicate that this oxidation occurred under partially saturated conditions. Groundwater flow simulations suggest that the water table was much lower and that a thick partially saturated zones was possible during the drier Altithermal period (11,000 to 3,000 years B.P.). The following chemical processes account for the major ions that are found in the groundwater but were generated when the partially saturated zone existed. The oxidation of reduced S produced SO4(2) and H(+). The H(+) reacted with carbonate minerals under elevated p sub CO2, with Ca(2+) loss by exchange for Na(+) and gypsum precipitation. Volume shrinkage in the weathered till resulting from these geochemical processes may have enhanced the development of fractures and caused the associated increased hydraulic conductivity. (Lantz-PTT)
W86-04160

SOLUTE DISPERSION IN MULTIDIMENSIONAL PERIODIC SATURATED POROUS MEDIA,
Mississippi Univ., University. Dept. of Civil Engineering.
V. K. Gupta, and R. N. Bhattacharya.
Water Resources Research WRERAO, Vol. 22, No. 2, p 156-164, February 1986. 1 fig, 25 ref. NSF Grant Nos. ECE-8513638, ECE-8513980 and CME-8004498.

Descriptors: *Solute transport, *Porus media, *Saturation, *Mathematical analysis, Gaussian density, Aquifers, Velocity, Dispersion coefficients, Parametric hydrology, Path of pollutants.

If in a convection-dispersion equation, governing solute movement in a saturated porous medium of infinite extent, the convection velocity components are periodic functions of spatial coordinates, then it follows from a general mathematical result that the solute concentration can be asymptotically approximated by a Gaussian density. Two theoretical examples, with and without a constant vertical velocity, are given to illustrate an application of this mathematical result to solute dispersion in a parallel-bedded, three-dimensional aquifer of infinite extent. Analytical expressions are obtained for dispersion coefficients in the asymptotic Gaussian approximations in the two examples. The dispersion coefficients functionally depend on a velocity scaling parameter U sub o and a spatial scaling parameter (period) a via their product aU sub o, and this functional dependence on aU sub o is different in the two examples. The expressions for dispersion coefficients are formally contrasted and compared with those obtained previously by other authors in a parallel-bedded infinite aquifer in which the convection velocity is a random field. Some physical implications of dependence of dispersion coefficients on a spatial scaling parameter (i.e., the scale effect) are discussed in the context of modeling in an aquifer with evolving heterogeneities. This interpretation of 'scale effect' in dispersion coefficients is contrasted with the preasymptotic interpretation in the current literature. (Author's abstract)
W86-04170

STOCHASTIC MODELING OF THE SPACE-TIME STRUCTURE OF ATMOSPHERIC CHEMICAL DEPOSITION,
Washington Univ., Seattle. Geophysics Program.
For primary bibliographic entry see Field 5B.
W86-04171

REGULATING FACTORS OF THE CONCENTRATION OF DISSOLVED CARBOHYDRATES IN A CENTRAL WATER COLUMN OF LAKE SUWA, JAPAN,
Yamagata Univ. (Japan). Dept. of Chemistry.
Y. Satoh, H. Hayashi, N. Nakamoto, and T. Okino.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 299-319, January 1986. 11 fig, 2 tab, 57 ref. Japan Ministry of Education Grant No. 503040.

Descriptors: *Water columns, *Dissolved carbohydrates, *Lake Suwa, *Japan, Water chemistry, Dissolved organic carbon, Ammonia, Phosphates, Nitrates, Nitrites, Phytoplankton, Bacteria, Ecosystems.

In order to elucidate the interrelationships between dissolved carbohydrates (DCHO) and other chemical and biological parameters, and to make clear the regulating factors of the concentration of DCHO, a 15 month observation was carried out in a central water column of a eutrophic lake, Lake Suwa, in Japan. The results include the vertical and seasonal changes in the concentration of DCHO, seasonal changes in the standing stock of DCHO, seasonal changes in the ratio of DCHO/DOC and correlation. The concentrations of DOC, ammonia, reactive phosphate, Chl-a and seston were positively and nitrite and nitrate were inversely correlated with the concentration of DCHO at $p = 0.01$ level. The study suggests the following: 1) Phytoplankton played the role of supplier of DCHO, through the release of photosynthetic carbohydrates or those contained in

sheath materials; 2) Aquatic animals also take part in the supply of DCHO probably through damaging phytoplankton during feeding, from which carbohydrates may be lost into water; 3) Heterotrophic bacteria solubilize carbohydrates contained in decomposing particulate organic matter, and at the same time they consume DCHO. Thus heterotrophic bacteria have two faces of suppliers and consumers; and, 4) The combined effect caused by primary producers, secondary producers and decomposers controls the vertical and seasonal changes in the concentration of DCHO in Lake Suwa. (Lantz-PTT)
W86-04182

UPTAKE OF INORGANIC CARBON AND NITROGEN BY PHYTOPLANKTON DURING THE WINTER MIXING PERIOD IN A FRESHWATER LAKE, LAKE NAKANUMA, JAPAN,
Tsukuba Univ. (Japan). Inst. of Biological Sciences.
For primary bibliographic entry see Field 2H.
W86-04185

COMPARISON OF METHODS FOR THE CONCENTRATION OF SUSPENDED SEDIMENT IN RIVER WATER FOR SUBSEQUENT CHEMICAL ANALYSIS,
Geological Survey, Doraville, GA. Water Resources Div.
For primary bibliographic entry see Field 5A.
W86-04225

WATER SOLUBILITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Syntex Research, Inc., Palo Alto, CA.
For primary bibliographic entry see Field 5B.
W86-04227

INSIGHT INTO THE MECHANISM OF ACCUMULATION OF ARSENATE AND PHOSPHATE IN HYDRO LAKE SEDIMENTS BY MEASURING THE RATE OF DISSOLUTION WITH ETHYLENEDIAMINETETRAACETIC ACID,
Auckland Univ. (New Zealand). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04228

SHORT-TERM STABILITY OF TRACE METALS IN ESTUARINE WATER SAMPLES,
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 2L.
W86-04232

USE OF HYDROGEOCHEMICAL PATTERNS IN CARBONATE SAND AND SANDSTONE AQUIFERS TO IDENTIFY INTRUSION AND FLUSHING OF SALINE WATER,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
A. Mercado.
Groundwater GRWAAP, Vol. 23, No.5, p 635-645, September-October 1985. 9 fig, 2 tab, 13 ref, 2 append.

Descriptors: *Coastal Aquifers, *Saline Water Intrusion, *Flushing, Chemical Properties, Hardness, Salinity, Israel, Groundwater, Halides, Sulfates.

Chemical analyses of wells penetrating the coastal aquifer of Israel indicate that the relative concentrations of sodium, calcium, magnesium, bicarbonate, and hydrogen species deviate considerably from the ideal mixing line between fresh water and sea water, as represented by the concentration of chlorides. Deviation patterns were found to be distinctly different for areas of present sea-water intrusion, and areas from which ancient brines are still flushed. These differences, explainable in major part as the combined effects of cation exchange and carbonate equilibria, can be utilized to distinguish between invading and retreating saline-water bodies, and identify their existence at the very beginning of the salinization process. Among the parameters investigated, it is recommended that combined parameters, such as Na/Cl, sodium adsorption ratio, and noncarbonate hardness, be preferred over the concentration plots of single ions. Observed patterns are verified with the aid of a single-cell simulation model. (Peters-PTT)
W86-04241

GROUND-WATER PROBLEMS IN THE MESOZOIC PAX MOUNTAIN FAULT ZONE,
Clemson Univ., SC. Dept. of Chemistry and Geology.
For primary bibliographic entry see Field 2F.
W86-04282

DISCRIMINATION OF GROUNDWATER SOURCES USING CLUSTER ANALYSIS, MANOVA, CANONICAL ANALYSIS AND DISCRIMINANT ANALYSIS,
Idaho Univ., Moscow. Dept. of Mathematics and Applied Statistics.
For primary bibliographic entry see Field 2F.
W86-04312

STRONTIUM AND ITS ISOTOPES IN CANADIAN RIVERS: FLUXES AND GLOBAL IMPLICATIONS,
Ottawa Univ. (Ontario). Dept. of Geology.
M. A. Wadleigh, J. Veizer, and C. Brooks.
Geochimica et Cosmochimica Acta GCACAK, Vol. 49, No. 8 p 1727-1736, August 1985.

Descriptors: *Geochemistry, *Strontium, *Isotopes, *Rivers, *Canada, Environmental effects, Dissolved solids, Geohydrology, Carbonates, Scates, Calcium, Chlorine.

Systematic sampling of the 39 largest Canadian rivers shows that the weighted average 87-Sr/86-Sr ratio in the dissolved load is 0.7111, similar to previous measurements on such large rivers as the Amazon and Mississippi. Consequently, it is believed that the above estimate is likely representative of the global average. This imposes a limit of 6.8 times 10 to the 11th power gm/yr on the amount of Sr exchanged with basalts in hydrothermal cells on mid-oceanic ridges. Evaluation of geological information suggests that Sr from silicate sources is of considerable importance for all but the largest Canadian rives. The latter have chemical and isotopic composition consistent with approximately 4:1 carbonate vs. silicate derivation of Sr, but such interpretation is not unique. In terms of their water discharge, the 39 Canadian rivers studied account for 4.2% of the world total and their weighted average concentrations for other dissolved solutes are: TDS 176 ppm, Ca 18 ppm and Sr 84 ppb. (Author's abstract)
W86-04348

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. II. ARGENTIERE (FRENCH ALPS): BULK MELT WATERS WITH OPEN-SYSTEM CHARACTERISTICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04352

CHEMICAL MODELS OF SOLUTE ACQUISITION IN GLACIAL MELT WATERS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04353

INSTRUMENTS AND METHODS. FIELD PH DETERMINATIONS IN GLACIAL MELT WATERS,
Manchester Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 7B.
W86-04355

SOIL WATER SAMPLERS IN ION BALANCE STUDIES ON ACIDIC FOREST SOILS,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
For primary bibliographic entry see Field 7B.
W86-04364

METHODS FOR VALIDATION OF PRECIPITATION PH: APPLICATIONS TO TEXAS DATA,
Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
For primary bibliographic entry see Field 5A.
W86-04389

SPECIFIC CONDUCTANCE AS AN INDICATOR OF TOTAL DISSOLVED SOLIDS IN COLD, DILUTE WATERS,
Institute of Hydrology, Wallingford (England).
A. G. Thomas.
Hydrological Sciences -- Journal -- des Sciences Hydologiques HSJODN, Vol. 31, No. 1, p 81-92, March 1986. 4 fig, 3 tab, 15 ref.

Descriptors: *Specific conductivity, *Total dissolved solids, *Temperature, *Error analysis, *Ions, Statistical methods, Cairngorm Mountains, Scotland.

Specific conductance is shown to bear a well-defined, linear relationship to total dissolved solids for a cold, low-ionic strength stream in the Cairngorm Mountains, Scotland. Unless the water temperature is constant, it is necessary first to correct the conductivity data to 25 C. This temperature correction may be taken as linear, even below 4 C, but not necessarily to be 2% per degree C as is commonly used. The error incurred by assuming the 2% figure for cold streams could be greater than 5%. Values of specific conductance using data for the limiting equivalent conductivities of the individual ions are shown to be poor estimates of actual specific conductances even for these dilute waters. Relationships between total dissolved solids and specific conductances may be impaired by changing proportions of ionic species in the samples. In general, however, an empirical straight line provided a good fit. (Rochester-PTT)
W86-04394

NITRIFICATION, NITRATE REDUCTION, AND NITROGEN IMMOBILIZATION IN A TIDAL FRESHWATER MARSH SEDIMENT,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
W. B. Bowden.
Ecology ECOLAR, Vol. 67, No. 1, p 88-99, February 1986. 4 fig, 3 tab, 59 ref.

Descriptors: *Nitrification, *Nitrate reduction, *Nitrogen immobilization, *Marsh sediments, Freshwater marshes, Ammonium, Nitrates, Path of pollutants, Litter.

The dominant microbial transformations of ammonium and nitrate in the sediments of a tidal freshwater marsh were estimated from measured rates of isotope dilution of ammonium (15-N) added to sediment and litter samples, reduction of nitrate (15-N) to ammonium (15-N) in fresh sediments, and net exchange of ammonium and nitrate between the marsh and river water in flumes built in the field. In two separate laboratory experiments, nitrification in mixed, fresh, surface sediments was 2.8 and 3.4 nanomoles/cu m/hr. Additions of nitrate (15-N) to fresh sediments showed that nitrate produced from ammonium by nitrification was reduced very quickly. Less than 10% of this nitrate was reduced back to ammonium by dissimilation. The net transfer of nitrate in this marsh is to the sediments, and since nitrate does not accumulate in these sediments, the remaining nitrate produced by nitrification must be reduced by denitrification or by assimilatory nitrate reduction. Ammonium was removed quickly from filtered and aerated river water that was mixed with plant litter in laboratory incubations. Ammonium-N removal from experimental flasks (215 nanomoles/g/hr) was dependent on the presence of litter and was biologically mediated, but was not due to nitrification since nitrate concentrations were constant in the same experiments. Under anaerobic conditions, ammonium-N was released from litter to river water (93 nano-

moles/g/hr). The estimated total rate of ammonium-N immobilization by microbes on aerobic litter (130 micromoles/sq m/hr) agrees well with measured losses of ammonium from river water in field flume studies (156 micromoles/sq m/hr). An aerobic litter layer may enable marshes to regulate the loss of ammonium that is regenerated in reduced, subsurface sediments and that would otherwise be lost by diffusion or advection. (Lantz-PTT)
W86-04399

INTERNAL FACTORS CONTROLLING PEATLAND-LAKE ECOSYSTEM DEVELOPMENT,
Wisconsin Univ.-Madison. Center for Limnology.
For primary bibliographic entry see Field 2H.
W86-04400

TRACE ORGANIC COMPOUNDS IN RAIN. 4. IDENTITIES, CONCENTRATIONS, AND SCAVENGING MECHANISMS FOR PHENOLS IN URBAN AIR AND RAIN,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W86-04422

LEAD CYCLING IN AN ACIDIC ADIRONDACK LAKE,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. R. White, and C. T. Driscoll.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1182-1187, December 1985. 5 fig, 6 tab, 42 ref. NSF Grant No. CME-8006733.

Descriptors: *Lead, *Lake sediments, *Acidic water, *Aluminum, *Fate of pollutants, Trace metals, Deposition, Seasonal variation, Temporal distribution, Spatial distribution, Heavy metals, Hydrogen ion concentration, Organic carbon, Particulate matter, Chemical stratification, Stratification, Metals, Lead, Darts Lake, New York, Aluminum, Acid rain.

A water column and sediment trap monitoring program was used to study important mechanisms regulating the chemistry and cycling of Pb in dilute acidic Darts Lake, Adirondack State Park, New York. Temporal and spatial variations in the concentration and transport of Pb were observed; vertical deposition of Pb through the water column was most pronounced during stratification periods (winter and summer), while during high flow (spring and autumn), Pb was more conservative within the lake. Deposition of particulate Pb was strongly correlated with Al and organic carbon deposition. Increases in metal (Pb and Al) deposition coincided with periods of increasing pH. It seems likely that in-lake formation of particulate Al facilitates the vertical transport of Pb in Darts Lake. (Geiger - PTT)
W86-04425

IMPLICATIONS OF A GRADIENT IN ACID AND ION DEPOSITION ACROSS THE NORTHERN GREAT LAKES STATES,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W86-04431

SNOW CHEMISTRY OF THE CASCADE-SIERRA NEVADA MOUNTAINS,
Geological Survey, Tacoma, WA. Water Resources Div.
For primary bibliographic entry see Field 5B.
W86-04442

DIAGENETIC TRACE-METAL PROFILES IN ARCTIC LAKE SEDIMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
For primary bibliographic entry see Field 5B.
W86-04444

DOES FLUORIDATION OF DRINKING-WATER PREVENT BONE FRAGILITY AND OSTEOPOROSIS,
National Board of Health, Helsinki (Finland).
For primary bibliographic entry see Field 5F.
W86-04453

CONCENTRATION OF TRACE ELEMENTS IN WATER SAMPLES BY REDUCTIVE PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
For primary bibliographic entry see Field 5A.
W86-04456

DETERMINATION OF TRACE ELEMENTS IN RAINWATER BY TOTAL-REFLECTION X-RAY FLUORESCENCE,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik.
For primary bibliographic entry see Field 5A.
W86-04457

EXTRACTION OF ARSENIC (III) AND ARSENIC (V) FROM NATURAL WATERS FOR NEUTRON ACTIVATION ANALYSIS,
Idaho Univ., Moscow. Dept. of Chemistry.
W. M. Mok, N. K. Shah, and C. M. Wai.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 110-113, January 1986. 1 fig, 3 tab, 15 ref.

Descriptors: *Arsenic, *Neutron activation analysis, *Natural waters, Quantitative analysis, Speciation, Nitric acid, Chemical analysis.

Because of its toxicity and possible carcinogenicity, arsenic is one of the most widely measured trace metals in many environmental monitoring programs. Arsenic generally occurs in the oxidation states as Arsenic (III) and Arsenic(V) in natural water systems. Quantification and speciation of As(III) and As(V), can be achieved by extracting the former species with pyrrolidinecarbodithioate at pH 1-1.5 into chloroform, followed by a nitric acid back extraction for neutron activation analysis (NAA). Besides eliminating interferences from matrix species in natural waters, the two-step extraction procedure also provides a large preconcentration factor for arsenic. Detection of 0.1 microgram/L of arsenic can be achieved by using this extraction method and NAA. Applications of this method to arsenic speciation studies in natural water systems are discussed. (Lantz-PTT)
W86-04461

DISSOLVED IRON IN CHALK GROUNDWATERS FROM NORFOLK, ENGLAND,
Academia Sinica, Beijing (China). Inst. of Technology.
S. Lin-Hua, and T. C. Atkinson.
Quarterly Journal of Engineering Geology SSQJEGA, Vol. 18, No. 3, p 261-274, 1985. 9 fig, 3 tab, 20 ref.

Descriptors: *Groundwater, *England, *Chemical reactions, *Chalk aquifiers, *Iron, Chemical properties, River Bure, Oxidation-redirection potential, Aquifiers, Hydrogen ion concentration, Iron bacteria, Groundwater movement, Groundwater recharge, Soil types.

The result of a hydrochemical survey of groundwater in the upper catchment of the River Bure in Norfolk, England, is reported, and the occurrence of iron is related to chemical reactions between water and rock and within the water itself, as well as to the groundwater flow pattern. In the upper River Bure catchment in Norfolk the Chalk aquifer is covered by sand and gravel drift aquifers and a leaky till aquiclude. Iron contents of groundwaters are several mg/liter beneath till, but less beneath valleys where till is not present. The iron contents and redox potentials of chalk waters are related to groundwater flow in two separate circulation cells. In the larger cell, chalk beneath the higher parts of the catchment receives recharge which has high Fe and low redox potential due to oxidation of pyrite in the drift formations. Iron contents in the chalk groundwater decrease with depth and towards discharge areas. Iron content decreases further where groundwater discharges upwards beneath the Bure valley and mixes with waters of the second circulation cell which occurs where the till has been removed by erosion. Oxygenated, iron-poor waters recharge the chalk beneath the upper parts of the valley floor. Mixing between waters in the two cells may cause precipitation of iron oxides. Similar flow patterns have been demonstrated elsewhere in East Anglia. It is likely that iron contents will generally be lowest where active groundwater circulation occurs beneath till-free valley floors. (Peters-PTT)
W86-04678

MODEL FOR THE DISTRIBUTION OF SULFATE REDUCTION AND METHANOGENESIS IN FRESHWATER SEDIMENTS,
Michigan State Univ., Hickory Corners. W.K. Kellogg Biological Station.
For primary bibliographic entry see Field 2H.
W86-04680

DISSOLVED ALUMINUM IN THE TAMAR ESTUARY, SOUTHWEST ENGLAND,
Institute for Marine Environmental Research, Plymouth (England).
For primary bibliographic entry see Field 2L.
W86-04681

2L. Estuaries

BEHAVIOR OF METHYLTIN COMPOUNDS UNDER SIMULATED ESTUARINE CONDITIONS,
New Hampshire Univ., Durham. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04133

DIMENSIONAL DIFFERENTIATION BETWEEN FIVE PLANKTONIC ORGANISMS LIVING IN TWO AREAS CHARACTERIZED BY DIFFERENT SALINITY CONDITIONS,
Athens Univ. (Greece). Zoological Lab. and Museum.
For primary bibliographic entry see Field 5C.
W86-04187

SHORT-TERM STABILITY OF TRACE METALS IN ESTUARINE WATER SAMPLES,
Water Research Centre, Medmenham (England). Medmenham Lab.
J. A. Campbell, M. J. Gardner, and A. M. Gunn.
Analytica Chimica Acta, Vol. 176, p 193-200, October 31, 1985. 1 fig, 2 tab, 4 ref.

Descriptors: *Estuaries, Data Acquisition, *Trace Metals, *Mersey River, Copper, Nickel, Cadmium, Lead, Sample Preservation, Chemical Analysis.

As part of a survey of metal concentrations in the estuary of the river Mersey, a study was undertaken to assess the changes that can take place over a 24 hr period, which is roughly equivalent to the period between sample collection and laboratory analysis. The estuarine water samples with high (22%) and low (<1%) salinity, were stored unacidified in polythene containers prior to filtration, preservation and determination of dissolved trace metals. For the low-salinity sample a massive (140%) increase in copper concentration was observed, indicating desorption from the particulate phase; a similar, although less pronounced (11%) effect was found for the high-salinity sample. Evidence was also obtained for a significant loss (30%) of lead from a pre-filtered low-salinity sample, suggesting appreciable adsorption to the container walls. For cadmium and nickel, no substantial changes in concentration were observed. The zinc results were subject to contamination and no useful conclusions could be drawn. The apparent instability of copper in estuarine water samples points to the need for an appropriate protocol to prevent the generation of seriously biased data. (Peters-PTT)
W86-04232

USE OF HYDROGEOCHEMICAL PATTERNS IN CARBONATE SAND AND SANDSTONE AQUIFERS TO IDENTIFY INTRUSION AND FLUSHING OF SALINE WATER,
TAHAL-Water Planning for Israel Ltd., Tel-Aviv.
For primary bibliographic entry see Field 2K.
W86-04241

SIMPLE MODEL OF ESTUARINE SUBTIDAL FLUCTUATIONS FORCED BY LOCAL AND REMOTE WIND STRESS,
Delaware Univ., Newark. Coll. of Marine Studies.
R. W. Garvine.
Journal of Geophysical Research, Vol. 90, No. C6, p 11,945-11,948, November 1985. 2 fig, 7 ref. OCE-8315207.

Descriptors: *Estuaries, *Mathematical Models, *Wind, *Tides, Water Currents, Sea Level, Ekman Transport, Chesapeake Bay, Delaware Estuary.

Observations of estuarine low subtidal sealevel and current fluctuations have often shown domination by the remote effects of the wind, acting on the adjacent coastal ocean, over the local surface stress, acting on the estuary itself. The remote effects are transmitted to the estuary by impressment on its mouth of sea level change induced by the onshore component of coastal Ekman transport and become increasingly dominant as the frequency decreases. A simple, linear, barotropic model was developed to investigate the joint action of these two wind forcing mechanisms. The relative shortness of most estuaries relative to low subtidal estuarine wavelengths explains the dominance of the remote effect for both sea level and barotropic current fluctuations in the estuary. For the same reason, however, surface slope is dominated by local wind setup. For an estuary with axis nearly parallel to the coast the two effects will operate either in concert or in opposition, depending on hemisphere and orientation of the estuary axis relative to the coast. For the geometries of both Chesapeake Bay and the Delaware Estuary the model predicts opposition with the remote effect dominant at lower frequencies, consistent with recent observations. (Author's abstract)
W86-04244

VARIABILITY OF SUBTIDAL CURRENT STRUCTURE IN A FJORD ESTUARY: PUGET SOUND, WASHINGTON,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
D. E. Bretschneider, G. A. Cannon, J. R. Holbrook, and D. J. Pashinski.
Journal of Geophysical Research, Vol. 90, No. C6, p 11,949-11,958, November 20, 1985. 11 fig, 2 tab, 28 ref.

Descriptors: *Estuaries, *Fjords, *Water Currents, *Wind, *Tides, *Puget Sound, Water Properties, Temperature, Salinity, Density, Physical Properties, Chemical Properties.

Simultaneous observations of currents and water properties were made in a section across East Passage in Puget Sound over a 31-day period between March and April 1983. These observations, supplemented with CTD profiles, shore-based wind data, and far-field current measurements, were used to describe the cross-channel variability of subtidal currents. The mean circulation consisted of seaward flow in the near surface and landward flow below 7 m, with a core of maximum velocity at mid-depth. Volume transport was 22,000 cum/s. Topographic effects force most of the seaward compensating flow through an adjacent channel, creating a clockwise circulation around an intervening island. Empirical orthogonal function analysis was used to describe the spatial structure of current fluctuations. At subtidal time scales, three circulation modes are evident: (1) a near-surface (upper 20 m), wind-driven shear; (2) a near-bottom layer (150-200 m) dominated by density currents that propagate up estuary after generation during neap tidal mixing at the entrance sill to Puget Sound; and (3) an intermediate layer (3) 25-75 m) influenced by partial refluxing of Colvos Passage water and modulated at fortnightly periods by nonlinear mixed tides. These current observations are the first to show recirculation of seaward flowing water from Colvos Passage to landward flow in East Passage. (Peters-PTT)
W86-04245

SOLUTE-TRANSPORT SIMULATION OF BRACKISH-WATER INTRUSION NEAR BALTIMORE, MARYLAND,
For primary bibliographic entry see Field 5B.
W86-04274

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. I. FJALLSJOKULL (SOUTH-EAST ICELAND): BULK MELT WATERS WITH CLOSED-SYSTEM CHARACTERISTICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04351

NITRIFICATION, NITRATE REDUCTION, AND NITROGEN IMMOBILIZATION IN A TIDAL FRESHWATER MARSH SEDIMENT,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2K.
W86-04399

GEOCHEMISTRY OF SUSPENDED PARTICULATE MATTER IN TWO NATURAL SEDIMENTATION BASINS OF THE RIVER RHINE,
Technische Hogeschool Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
For primary bibliographic entry see Field 5B.
W86-04547

ASSESSING PHOSPHORUS CONTROL IN THE JAMES RIVER BASIN,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04640

SULFATE-REDUCING BACTERIA: PRINCIPAL METHYLATORS OF MERCURY IN ANOXIC ESTUARINE SEDIMENT,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
For primary bibliographic entry see Field 5B.
W86-04676

DISSOLVED ALUMINUM IN THE TAMAR ESTUARY, SOUTHWEST ENGLAND,
Institute for Marine Environmental Research, Plymouth (England).
A. W. Morris, R. J. M. Howland, and A. J. Bale.
Geichimica et Cosmochimica Acta GCACAK, Vol. 50, No. 2, p 189-197, February 1986. 7 fig, 2 tab, 36 ref. U. K. Dept. of Environmental Contracts 480/684 and PECD 7/1/076.

Descriptors: *Estuaries, *Aluminum, *Tamar Estuary, *Chemical Reactions, Sediments, Tidal effects, Colloids, Solubility.

Distributions of dissolved Al in the Tamar Estuary were recorded through spring-neap tidal cycles in winter and summer. Dissolved Al is a highly reactive constituent in this estuary, undergoing net removal in the very low salinity region and net input to the mid-estuary. The extent of both the depletion and the augmentation varied systematically with tidal energy input, indicating that tidal sediment disturbance was the principal controlling agency. These field data, supported by the results of laboratory simulations, show that the removal is regulated by sorption onto resuspended sediment particles, which dominates kinetically over authigenic aluminosilicate formation. removal of dissolved Al by flocculation of riverborne colloids is not significant. The mid-estuarine input is consistent with dissolution of authigenic aluminosilicate following net remobilization of estuarine sediment. The internal cycling of Al in the estuary, generated by these processes, alters both the time-course and the soluble-particulate balance of the riverine discharge of Al to the adjacent coastal water. (Author's Abstract)
W86-04681

3. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

DESALINATION PLANT TECHNOLOGY OPTIMISATION,
Tractionel S.A., Brussels (Belgium).
R. Muylle.
Aqua AQUAAA, No. 1, p 5-9, 8 fig, 3 tab.

Descriptors: *Desalination, *Desalination plants, *Reverse osmosis, *Distillation, Water treatment facilities, Water supply development, Water use, Drinking water, Economic aspects.

The most common water treatments are filtration with or without flocculation-settling. But, when available water salt content is too high to meet international local rules or recommendations, a salt reducing treatment must be provided. For other waters, two main desalination technologies remain on the market: reverse osmosis (RO) and distillation. If the two technologies are compared, taking, as an example, a 100,000 cu m/day plant somewhere in a Middle East country, with the following characteristics (only valid for one special case): (1) a net constant production of 100,000 cu m/day: for RO:102.5% installed capacity; for MSF, taking into account the combined fiability and availability for both desalination and electrical power plants, four units with a total capacity of 120,000 cu m/day may be installed giving a load factor of 83% (special case, allowing a water shortage during a few periods of time during the year); (2) to obtain non-corrosive drinking water from MSF distillation plant, some modifications are needed, like addition of O2 (air), CO2, lime, Cl2; (3) energy: for RO, it is assumed that electricity is taken out of the network; for MSF, a dual purpose plan is provided and an optimization study (special case) shows production of steam and electricity should be economically produced with boilers and back pressure turbines. Excess of electricity is provided to be fed in the electrical network. These values are to be taken with caution due to the high influence of each parameter on the water cost, especially the cost of: fuel, electricity, chemicals, manpower. Each special case must be studied taking into account each parameter, local prices and market fluctuation. (Lantz-PTT)
W86-04148

DESALINATION - TECHNOLOGICAL TRENDS AND OPERATIONAL RESULTS (LE DESSALEMENT - CHOIX TECHNIQUES ET RESULTATS DE PRODUCTION,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
J. M. Rovel.
Aqua AQUAAA, No. 1, p 10-13, 1986. 4 fig, 6 tab, 4 ref.

Descriptors: *Desalination, *Reverse osmosis, *Water supply, development, Salbukh, Saudi Arabia, Desalination apparatus, Desalination plants, Water treatment.

The first part of this report describes the different technological trends applied in desalting, more specifically in the case of the Reverse Osmosis. This process and the related design of the Salbukh Plant (Saudi Arabia) is presented in detail, with an emphasis on the application of the design principles described in the first part. Also, the results obtained on this plant show that the plant design complies with the production requirements and the site constraints. (Author's abstract)
W86-04149

3B. Water Yield Improvement

PHYSICAL RESPONSE OF CONVECTIVE CLOUDS OVER THE SIERRA NEVADA TO SEEDING WITH DRY ICE,
Electronics Techniques, Inc., Auburn, CA.
A. W. Huggins, and A. R. Rodi.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 10, p 1082-1098, October 1985. 27 fig, 22 ref. Bureau of Reclamation Contract Nos. 9-07-85-V0021, 4-CR-81-03860, and 2-07-81-V0256.

Descriptors: *Cloud seeding, *Weather modification, *Radar, *Clouds, Remote sensing, Artificial precipitation, Precipitation, Supercooled liquid water, Sierra Nevada, California, Dry ice.

The effect of seeding convective clouds with dry ice was studied using simultaneous aircraft and radar observations. Clouds that were initially ice-free with suspercooled liquid water contents of 0.5 g/cu m when the tops reached the -10 degrees level had similar responses to seeding, although significant natural variability existed. Aircraft particle probes detected sharp increases of small crystals (<100 micrometers) in 3-6 min followed by >1 mm aggregates about 10 min after seeding. Observations supported in the expectation that riming growth should not be important at these liquid water contents. Initial radar echoes formed in 7 min with distinctive time-height profiles of reflectivity. Most radar echoes forming downwind of the seeding line were small and relatively weak compared with the natural echoes forming further downwind over the mountains. The impact of the seeding was shown to be observable but relatively small. It was found that unseeded clouds formed radar echoes later, and produced reflectivity time-height profiles that were significantly different from the seeded ones. the differences are considered in part to be due to variability in the initial cloud properties as well as the obvious and well-documented effects of injection of the seeding material early in the cloud lifetime. While the meteorological impact was small, documentation of the evolution of the seeding effect from cloud to ground is a prerequisite to further experimentation. (Author's abstract)
W86-04628

DISPOSITION OF SILVER RELEASED FROM SOVIET OBLAKO ROCKETS IN PRECIPITATION DURING THE HAIL SUPPRESSION EXPERIMENT GROSSVERSUCH IV. PART II: CASE STUDIES OF SEEDED CELLS,
Clermont-Ferrand-2 Univ., Aubiere (France).
J. P. Lacaux, J. A. Warburton, J. Fournet-Fayard, and P. Waldteufel.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 9, p 977-992, September 1985. 15 fig, 6 tab, 12 ref. DGRST Grant 78-7-2847 and NSF Grant ENV 77-01600.

Descriptors: *Cloud seeding, *Weather modification, *Silver, *Hail, *Radar, *Precipitation intensity, Rainfall disposition, Precipitation, Clouds, Groissversuch, Switzerland, Silver iodide.

Cloud seeding quality was estimated in each of four seeded storms during the 1978 summer program of Grossversuch IV in Switzerland by observing the internal structure of storm cells with C, S and X-band radar, and the trajectory, time of residence and dispersion of the AgI aerosols in the seeded clouds with radar and chemical techniques. Seeding coverage was measured as the ratio of the surface area of precipitation in which the seeding chemical is found at the ground to the surface area of the rainfall (using the 40 dBZ radar reflectivity contour near the ground). Two cells in June with seeding coverages of 7 and 25%, respectively, had insufficient residence times for AgI in those portions of the cloud colder than -5 degrees. Two cells seeded in July which had seeding coverages of 100% had AgI residence times in cloud colder than -5 degrees of 500-700 seconds, which was adequate for modification of the water-ice balance. Positive correlations exist between precipitation intensity and seeding chemical concentration when the seeding aerosol has a long residence time in cloud colder than -5 degrees, except when the AgI aerosols are scavenged in a short period of time. The hail suppression plan for the Grossversuch IV experiment was designed in accordance with the Moldavian hail suppression organization. Although the Soviet criteria were met for seeding purposes in all cases, the results show that the reflectivity structure of the storms is also an important factor in assessing where and when the seeding agent should be injected to suppress hail growth. (Geiger-PTT)
W86-04630

PREDICTIONS BY TWO ONE-DIMENSIONAL CLOUD MODELS: A COMPARISON,
Illinois State Water Survey Div., Champaign.
For primary bibliographic entry see Field 2B.
W86-04632

3C. Use Of Water Of Impaired Quality

TREATMENT OPTIMIZATION OF MUNICIPAL WASTEWATER AND REUSE FOR REGIONAL IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
A. Dinar, and D. Yaron.
Water Resources Research WRERAO, Vol. 22, No. 3, p 331-338, March 1986. 8 tab, 24 ref. BARD Grant I-101-79.

Descriptors: *Water reuse, *Impaired water use, *Wastewater irrigation, *Municipal wastewater, Models, Wastewater renovation, Israel, Competing use, Effluents.

Municipal wastewater warrants increased attention as a potential environmental pollution and a possible irrigation water source. A long-run mathematical programming model aimed at regional optimization with regard to plant capacity, treatment level, allocation of the effluent to the participating farms, and cropping patterns at each farm is presented. The model is applied to an agricultural region in Israel which includes a town and several farms. The results indicate the necessity of a subsidy for regional cooperation and provide a regional setup of reusing municipal wastewater for irrigation. The optimal solution enables each farm to reallocate the freshwater quota among the different land sections, to cultivate new land areas, and to expand the irrigated crops by using effluent. (Author's abstract)
W86-04196

SHARING REGIONAL COOPERATIVE GAINS FROM REUSING EFFLUENT FOR IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 6C.
W86-04197

SOME ENVIRONMENTAL CONSEQUENCES OF WATER AND ENERGY CONSERVATION IN THE HANDLING OF MINE TAILINGS IN SUB-ARCTIC REGIONS,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
A. Sellgren.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 141-149, 1986. 8 fig, 8 ref.

Descriptors: *Water conservation, *Energy conservation, *Mine wastes, *Subarctic zone, Heat pump, Water quality standards, Water quality, Water reuse, Flotation, Aeration.

In the refining of ores large amounts of fine-grained mineral particles (tailings) are generally transported together with water (slurry) in pipelines, sometimes as far as several kilometers to the disposal area. Great savings of energy and water can be obtained at concentrators if the tailings slurry is thickened more effectively and water is reused directly instead of being transported the longway around the disposal area. With direct circulation in sub-arctic regions, large amounts of heating energy can be recovered using a heat pump arrangement. The potential savings at a Swedish concentrator were estimated to be about 10-20 GWh per year, the majority of which would be savings in oil. Furthermore, handling of mine tailings products at low water content offers environmental benefits, and more effective deposition techniques can be used. In cold areas, temperature and hydrological conditions greatly influence spreading and dissipation mechanisms of pollutants released in the process. Monthly variations of the discharge to the recipient of a substance emitted in the process were simulated in an example. The degree of direct circulation in flotation of complex sulphide ores may be limited by water quality problems in the process. A mathematical model was developed and used to simulate the accumulation of a substance in the process for different degrees of direct circulation. Finally, a schematic layout of a simple aeration plant for recycled process water was outlined and some regional water-related problems were discussed. (Author's abstract)
W86-04486

EFFECTS OF WATER REUSE, RECYCLING AND RESOURCE RECOVERY ON FOOD PROCESSING WASTE TREATMENT IN THAILAND,
Siametec International Ltd., Bangkok (Thailand).
For primary bibliographic entry see Field 5D.
W86-04513

SOURCES OF WATER TO THE SEAWATER WELL WHICH SUPPLIES THE FISH PONDS IN EILAT: IMPLICATIONS FOR FISHPOND MANAGEMENT,
National Mariculture Centre, Eilat (Israel).
For primary bibliographic entry see Field 5B.
W86-04576

3D. Conservation In Domestic and Municipal Use

MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN CIUDAD JUAREZ, MEXICO,
California State Univ., Fullerton. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-04535

3E. Conservation In Industry

SOME ENVIRONMENTAL CONSEQUENCES OF WATER AND ENERGY CONSERVATION IN THE HANDLING OF MINE TAILINGS IN SUB-ARCTIC REGIONS,
Luleaa Univ. (Sweden). Div. of Water Resources Engineering.
For primary bibliographic entry see Field 3C.
W86-04486

ULTRAPURE WATER IN THE ELECTRONICS INDUSTRY,
Esmil International B.V., Amsterdam (Netherlands).
For primary bibliographic entry see Field 5F.
W86-04518

PROCESS CONTROL AND DATA ACQUISITION COMPUTERS IN THE WATER INDUSTRY,
Brown Boveri Kent (East Africa) Pty Ltd., Singapore.
For primary bibliographic entry see Field 5G.
W86-04519

REDUCTION OF PULP AND PAPER INDUSTRY EFFLUENT LOADING,
Tampere Univ. of Technology (Finland).
For primary bibliographic entry see Field 5D.
W86-04521

MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN CIUDAD JUAREZ, MEXICO,
California State Univ., Fullerton. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-04535

SHORT-TERM HYDROELECTRIC SCHEDULING USING THE PROGRESSIVE OPTIMALITY ALGORITHM,
Asian Inst. of Tech., Bangkok (Thailand).
For primary bibliographic entry see Field 4A.
W86-04542

3F. Conservation In Agriculture

MODEL OF THE TERMINAL COMPLEX OF THE OUED R'HIR (ALGERIA),
Ecole Nationale Superieure des Mines de Paris, Fontainebleau (France). Centre d'Information Geologique.
For primary bibliographic entry see Field 2F.
W86-03992

REDUCED PRESSURE IRRIGATION INVESTMENT ECONOMICS,
South Dakota State Univ., Brookings. Dept. of Economics.
For primary bibliographic entry see Field 6C.
W86-04166

STOCHASTIC SOIL MOISTURE ESTIMATION AND FORECASTING FOR IRRIGATED FIELDS,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
For primary bibliographic entry see Field 2G.
W86-04172

EXPECTED UTILITY, BENEFIT, AND LOSS CRITERIA FOR SEASONAL WATER SUPPLY PLANNING,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 6B.
W86-04193

TREATMENT OPTIMIZATION OF MUNICIPAL WASTEWATER AND REUSE FOR REGIONAL IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 3C.
W86-04196

SHARING REGIONAL COOPERATIVE GAINS FROM REUSING EFFLUENT FOR IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 6C.
W86-04197

1984 DROUGHT ON THE CANADIAN PRAIRIES,
Saint Patrick's Coll., Maynooth (Ireland).
For primary bibliographic entry see Field 2G.
W86-04508

MEASURED AND CREAMS-PREDICTED NITROGEN LOSSES FROM TOMATO AND CORN MANAGEMENT SYSTEMS,
Southeast Kansas Branch Experiment Station, Parsons.
For primary bibliographic entry see Field 5B.
W86-04538

ECOLOGY OF ACHENE DIMORPHISM IN HETEROTHECA LATIFOLIA. III. CONSEQUENCES OF VARIED WATER AVAILABILITY,
Arizona Univ., Tucson. Dept. of Ecology and Evolutionary Biology.
For primary bibliographic entry see Field 2I.
W86-04618

WATER USE IN WINTER WHEAT AS INFLUENCED BY CEPHALOSPORIUM GRAMINEUM,
Montana State Univ., Bozeman. Dept. of Plant and Soil Science.
For primary bibliographic entry see Field 2I.
W86-04667

4. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control Of Water On The Surface

ANALYSIS OF STORAGE FOR THE REGULATION OF SURFACE WATER IN THE HUANG-HUAI-HAI PLAIN FOR SOUTH-TO-NORTH WATER TRANSFER,
Hebei Inst. of Geography, Shijiazhuang (China)
Y. Fenglan, and W. Wenkai.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p. 289-298, 2 fig, 2 tab.

Descriptors: *Water storage, *Water transfer, *China, Water supply development, Diversion, Canals, Irrigation, Economic aspects, Environmental effects, Water conveyance.

As part of the overall assessment of the south-north water transfer program proposed for eastern China, the storage of surface water in the Huang-Huai-Hai Plain is analyzed. The three main forms of storage of water resources are discussed. They include: surface reservoirs, and underground reservoirs with emphasis on ponds; reticulated reservoirs on the plain formed by natural channels, deep trench waterway networks, ponds, lowlands and shallow lakes. Water storage has a very large impact on the natural environment. The need to consider environmental effects in the immediate surroundings of the storage areas in order to achieve useful storage without flooding or salinization, is discussed. (Halterman - PTT)
W86-03938

USING ANCIENT CHANNELS TO REGULATE WATER THROUGH STORAGE: THE EXAMPLE OF THE HEBEI PLAIN,
Hebei Inst. of Geography, Shijiazhuang (China)
W. Chen, and W. Jinxiang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 299-308, 3 fig, 2 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *China, Canals, Irrigation, Water storage, Water conveyance, Groundwater.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the potential use of underground storage is evaluated. There are many ancient channels buried at a depth of 30 to 50 m under the plains of the Hebei Province whose sand and gravel layers can provide ample storage capacity for groundwater. The 41 reservoirs present in the area have a combined capacity of 12.726 cu km. Most of the capacity is in alluvial fans, where paths of infiltration are best. The river channel belts have the next best conditions. Under present circumstances, the underground storage capacity of the deltas is not practical. Storage capacity and infiltration conditions are greater in the irrigation districts of the Middle Route. Capacity is less in the East Route irrigation districts and infiltration conditions are most deficient. (Halterman - PTT)
W86-03939

TOPOGRAPHIC PARTITION OF WATERSHEDS WITH DIGITAL ELEVATION MODELS,
Hunter Coll., New York. Dept. of Geology and Geography.
L. E. Band.
Water Resources Research WRERAO, Vol. 22, No. 1, p 15-24, January 1986. 10 fig, 27 ref.

Descriptors: *Topography, *Watershed management, *Digital elevation models, Partitioning, Network design, Channels, Runoff, Remote sensing, Hydrologic models, Simulation analysis.

Digital elevation models are used to automatically map the stream channel and divide networks of a watershed. These topographic skeletons are used to partition the watershed into a set of fundamental, runoff producing subregions, each of which drains into one stream link. Construction of a code describing the network topology, along with parallel files containing attribute information of each drainage area and associated stream link may form the basis for an efficient watershed information system. Registration of remotely sensed imagery and maps of important soils information to the digital elevation model allows an effective organization of this data as input to hydrologic simulation models. The methodology described here is designed to aid in the efficient parameterization of a distributed components approach to watershed simulation. (Author's abstract)
W86-04157

MANAGEMENT OF LAKE COMO: A MULTIOBJECTIVE ANALYSIS,
Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
For primary bibliographic entry see Field 6A.
W86-04165

STOCHASTIC MODEL OF SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2E.
W86-04192

OPTIMIZATION OF REAL-TIME RESERVOIR OPERATIONS WITH MARKOV DECISION PROCESSES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
D. Wang, and B. J. Adams.
Water Resources Research WRERAO, Vol. 22, No. 3, p 345-352, March 1986. 3 fig, 3 tab, 38 ref, 1 append.

Descriptors: *Reservoir operation, *Optimization, *Markov Process, Model studies, Policy making.

Reservoir inflows are described as periodic Markov processes, in recognition of hydrologic uncertainty and seasonality. The optimization of reservoir operations involves determination of the optimal release volumes in the successive time periods so that the expected total rewards from the operations are maximized. A two-stage optimization framework, which consists of a real time model followed by a steady state model, is proposed. The steady state model that describes the convergent nature of the prospective future operations is regarded as a periodic Markov decision process and is optimized with the generalized policy iteration procedure. This result is in turn used as an interim step for deriving the optimal immediate decisions for the current period in the real-time model. Significant computational efficiency results from this framework and the respective optimization procedure. (Lantz-PTT)
W86-04198

EVALUATION OF THORNTHWAITE'S WATER BALANCE TECHNIQUE IN PREDICTING STREAM RUNOFF IN COSTA RICA,
Instituto Tecnologico de Costa Rica, Cartago. Dept. de Ingenieria Forestal.
For primary bibliographic entry see Field 2E.

W86-04393

PARAMETRIC/NONPARAMETRIC MIXTURE DENSITY ESTIMATION WITH APPLICATION TO FLOOD-FREQUENCY ANALYSIS,
Texas Univ. at El Paso. Dept. of Mathematics.
For primary bibliographic entry see Field 2E.
W86-04531

BAYESIAN MODELS OF FORECASTED TIME SERIES,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W86-04532

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: II APPLICATION TO THE POTOMAC RIVER,
Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 2E.
W86-04534

SHORT-TERM HYDROELECTRIC SCHEDULING USING THE PROGRESSIVE OPTIMALITY ALGORITHM,
Asian Inst. of Tech., Bangkok (Thailand).
N. J. D. Lucas, and P. J. Perera.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1456-1458, September 1985. 3 fig, 3 ref.

Descriptors: *Computer programs, *Hydroelectric plants, *Reservoir releases, *Storage, *Mathematical models, Costs.

A computer code was developed to schedule the short-term release of water from cascaded hydroelectric plants. It was based on the progressive optimality algorithm. In practice, the code produced local optima. A simple example is presented here to confirm that this can happen. It is further demonstrated that the progressive optimality algorithm does not necessarily converge for nonconvex and discontinuous cost functions, although this claim has been made in the literature. The original theoretical proof of convergence required functions to be strictly convex with continuous first derivatives. This is the weakest sufficient condition the authors have found. (Rochester-PTT)
W86-04542

HYDROLOGICAL EFFECTS OF MOORLAND GRIPPING: A RE-APPRAISAL OF THE MOOR HOUSE RESEARCH,
Institute of Hydrology, Wallingford (England).
M. Robinson.
Journal of Environmental Management JEVMA, Vol. 21, No. 3, p 205-211, October 1985. 2 fig, 2 tab, 25 ref.

Descriptors: *Land use, *Rainfall-runoff relationships, *Drainage, *Drainage ditches, *Drainage effects, Storm runoff, Flood peak, Peat soil, Drainage area, Runoff, Flow measurement, Moor House National Reserve.

The purpose of this paper is to examine the whole period of record collected at Moor House National Nature Reserve, and to reassess the conclusions of earlier hydrological studies of land use changes in the light of more sophisticated analysis techniques and subsequent catchment studies. Measurements at four small peat moorland catchments show that artificial drainage by ditching increased peak flows. This increase was due to a change to faster storm runoff, rather than to a change in runoff volumes. Any effects of the drainage on low flows were small and of similar magnitude to the accuracy of the flow measurements. Severe burning of the peat surface also increased peak flows, although to a smaller extent than the change due to drainage. Burning reduced the storage capacity of the soil and lowered dry weather flows. It also led to a reduction in storm response times, and probably a slight increse in storm runoff volumes. (Geiger-PTT)
W86-04599

ROLE OF RECREATIONAL BOAT TRAFFIC IN INTERLAKE DISPERSAL OF MACROPHYTES: A NEW ZEALAND CASE STUDY,
New Zealand Electricity Dept., Hamilton.
For primary bibliographic entry see Field 5G.
W86-04604

4B. Groundwater Management

ANNUAL SUMMARY OF GROUND-WATER CONDITIONS IN ARIZONA, SPRING 1983 TO SPRING 1984,
Geological Survey, Tucson, AZ. Water Resources Div.
USGS Open-File Report 85-410, 1985. 2 sheets, 4 fig, 1 tab.

Descriptors: *Groundwater, *Groundwater availability, *Arizona, Groundwater basins, Groundwater depletion, Groundwater potential, Geohydrology, Groundwater level, Groundwater management, Groundwater reservoirs.

A summary map shows various aspects of groundwater availability in Arizona. Potential well production, in increments of 0 to 10 gpm, 10 to 500 gpm, and 50 to 2500 gpm (average 1000 gpm) os the primary emphasis of the map; however, data on changes in water level from spring 1983 to spring 1984, status of groundwater inventory, and estimated groundwater pumpage in Arizona in 1983, are also presented. The total water pumpage is also broken down by the following use categories: drainage, public supply, domestic, livestock, industrial and agricultural. (Halterman - PTT)
W86-03910

USING ANCIENT CHANNELS TO REGULATE WATER THROUGH STORAGE: THE EXAMPLE OF THE HEBEI PLAIN,
Hebei Inst. of Geography, Shijiazhuang (China)
For primary bibliographic entry see Field 4A.
W86-03939

CHANGES IN GROUND-WATER RESOURCES AS A RESULTS OF MINE DRAINAGE IN THE SEVEROURALSK BAUXITE AREA,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-03984

USE OF A MODEL FOR DETERMINING OPTIMUM RATES OF ARTIFICIAL RECHARGE OF THE CENOMANIAN AQUIFERS IN BEIRUT, LEBANON,
BURGEAP S.A., Paris (France).
M. C. d'Orval.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 219-228, 9 fig.

Descriptors: *Groundwater management, *Recharge, *Model studies, Injection, Artifical recharge, Groundwater recharge, Beirut, Lebanon, Aquifers.

Digital model simulation was used to study alternative recharge and operating conditions in the Beirut, Lebanon, region, considering the discharge available in the Nahr Beirut for injection purposes and the amounts of water needed to supply the city during the dry season. A schedule for injection was developed. It provided for a total of 12 million cu m/yr to be injected over seven months; November, 0.38 cu m/sec; December, 0.50 cu m/sec; and January to May, 0.77 cu m/sec. In the same area it would be possible to extract a total of 15.8 million cu m/yr spread over five months; June to August, 1.16 cu m/sec; September, 1.38 cu m/sec; and October 1.23 cu m/sec. (Cassar - PTT)
W86-03994

MODEL TO EVALUATE SALT WATER INTRUSION DUE TO DIFFERENT CONJUNCTIVE USE STRATEGIES IN COASTAL AQUIFERS IN SAUDI ARABIA,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04072

NITRATE CONCENTRATIONS IN MUNICIPAL WELLS LOCATED WITHIN A RIVER BED,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
Q. M. Nguyen, and M. W. Gilliland.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 135-137, 6 fig, 1 tab, 7 ref.

Descriptors: *Municipal wells, *Nitrates, *Modelling, *Drawdown, River beds, Alluvial aquifers, Groundwater pollution, Recharge, Wells, Water management, Management, Simulation, Platte River, Central Platte Valley, Nebraska.

Municipalities in the Central Platte Valley of Nebraska utilize the alluvial aquifer of the Platte River for drinking water. Of concern to these municipalities is the potential for nitrate contamination of these well fields. Such contamination could result from periods of low-flow or no-flow in the River, in part caused by increased diversions of River waste for irrigation upstream. Drawdown in the well field during these periods could allow high nitrate groundwater (25 to 50 mg/l NO3-N), to the north of the River to flow into the alluvial well field. This paper describes a management model which could manage the River and groundwater conjunctively for both quantity and quality, summarizing the model conceptually and mathematically, and provides results for three simulations. While not validated with a field test, model predictions are reasonable and accurate to the extent they can be compared to measured data. When validated, the model may be used to evaluate the impact of diversions for irrigation upstream on well field quality. (Lantz - PTT)
W86-04078

USE OF ELECTRICAL RESISTIVITY METHOD TO STUDY VERTICAL HYDROLOGIC BOUNDARIES IN WADI SUDR, SINAI PENINSULA, EGYPT,
King Faisal Univ., Al-Hasa (Saudi Arabia). Coll. of Agriculture.
For primary bibliographic entry see Field 2F.
W86-04097

MULTIPLE COMPLETION MONITOR WELLS,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
D. B. Nakamoto, F. R. McLaren, and P. J. Phillips.
Groundwater Monitoring Review, Vol. 6, No. 2, p 50-55, Spring 1986. 5 fig, 2 tab, 1 ref.

Descriptors: *Monitoring, *Drilling, *Drilling samples, Environmental effects, Cost analysis, Piezometers, Construction methods, Construction materials, Grouting.

The multiple completion monitor well design concept is discussed in terms of drilling methods, construction methods, cost considerations, and potentially adverse effects caused by the interactions between construction materials and groundwater. The air rotary casing hammer method is used to penetrate unconsolidated sediments and the remainder of the hole is drilled by the direct mud rotary method. Intervals for piezometer completions are based upon lithologic descriptions and downhole electrical logging. Piezometers are 2 1/2-inch and 1-inch blank pipes with 2 1/2-inch mill slotted and 1 1/4-inch wire wound perforated pipes. Each perforated pipe interval is within a gravel envelope. Cement grout (4 1/2 gallons water to 94 pounds cement) is used to seal the annular space between perforated intervals. Contracting costs for multiple completion monitor

wells are less than an equal set of single completion monitor wells. For example, a six completion monitor well, 300 ft deep, costs $15,300. Six single completion monitor wells with the same perforated intervals cost $46,800. The cost differences are mainly for drilling extra footage and installing more grout. The effectiveness of cement grout hydraulic seals by measuring differences in hydraulic heads within adjacent piezometers has been demonstrated. The integrity of the cement grout seals is also verified by differing water quality in adjacent piezometers. Cement grout seals have caused one adverse condition: an elevation of pH from 11 to 12. The problem is under investigation and alternate materials are being studied for seals. (Lantz-PTT)
W86-04207

SATURATED THICKNESS FOR DROUGHT AND LITIGATION PROTECTION,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
R. C. Peralta, P. W. Dutram, A. W. Peralta, and A. Yazdanian.
Ground Water GRWAAP, Vol. 24, No. 3, p 357-364, May-June 1986. 2 fig, 5 tab, 13 ref.

Descriptors: *Irrigation water, *Saturated thickness, *Drought, *Groundwater availability, *Litigation protection, Legal aspects, Competing use, Water deficits, Arkansas.

The legal doctrines of reasonable use and correlative rights are the recognized standards for resolving legal conflicts between interfering agricultural groundwater users in Arkansas. Assuring that an adequate saturated thickness exists for all interfering users throughout the groundwater withdrawal season provides water users with a degree of protection from both a successful litigious charge of 'unreasonable use' and a mandated curtailment of groundwater withdrawal in a drought season. The feasibility of maintaining a 'target' saturated thickness and water table elevation by implementing a district-wide sustained groundwater withdrawal strategy has been previously demonstrated. Several models have been reported which create the spatially distributed sustained-yield withdrawal strategies that will maintain those target levels. Using an iterative dynamic groundwater simulation model, initial (springtime) saturated thickness is assumed. The change in saturated thickness resulting from withdrawals during the irrigation season is compared with an acceptability criterion. The assumed springtime saturated thickness is varied until the criterion is satisfied. The result is the minimum springtime saturated thickness needed for groundwater users in a particular cell to achieve: (1) a measure of year-round protection from successful litigation charging unreasonable use, and (2) some assurance that they will not need to curtail or limit groundwater withdrawals during a drought season. This procedure was applied to a 3-mile by 3-mile (5-km by 5-km) cell in the Arkansas Grand Prairie, an important rice- and soybean producing area. The results indicate that a minimum of 13 feet (4 m) of saturated thickness are desirable for the center of the cell to provide for a drought season. (Lantz-PTT)
W86-04280

GROUNDWATER: SAVING THE UNSEEN RESOURCE,
For primary bibliographic entry see Field 5G.
W86-04360

CHARACTERIZATION OF DYE TRACER PLUMES: IN SITU FIELD EXPERIMENTS,
Battelle Memorial Inst., Columbus, OH.
For primary bibliographic entry see Field 2F.
W86-04468

ESTIMATING AQUIFER PERMEABILITY FROM FORMATION RESISTIVITY FACTORS,
Woodward-Clyde Consultants, Tallahassee, FL.
For primary bibliographic entry see Field 2F.
W86-04469

OPTIMAL CONTROL OF NONLINEAR GROUNDWATER HYDRAULICS: THEORETICAL DEVELOPMENT AND NUMERICAL EXPERIMENTS,
Humboldt State Univ., Arcata, CA. Dept. of Environmental Resources Engineering.
For primary bibliographic entry see Field 2F.
W86-04544

4C. Effects On Water Of Man's Non-Water Activities

CHANGES IN GROUND-WATER RESOURCES AS A RESULTS OF MINE DRAINAGE IN THE SEVEROURALSK BAUXITE AREA,
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2F.
W86-03984

SIMULATED OIL-SHALE MINE DEWATERING USING A CONFINED MULTIAQUIFER MODEL, PICEANCE BASIN, COLORADO, U.S.A.,
Geological Survey, Denver, CO.
J. B. Weeks.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 151-166, 10 fig, 6 ref.

Descriptors: *Mine drainage, *Groundwater, *Model studies, *Hydrologic models, *Colorado, Oil shale, Aquifers, Piceance Basin, Drainage, Dewatering, Shales.

A multiaquifer digital model was used to simulate the aquifer system in the Piceance basin, Colorado. Aquifer tests and geophysical data were used to evaluate the hydraulic characteristics of the system. The groundwater system was modeled in a steady state and calibrated by comparing the computed potentiometric surface with water level measurements collected from wells in the basin. The annual volume of groundwater recharge used in the model to obtain the steady-state solution was found to be within 10% of that estimated by the water budget. The only difficulty encountered in obtaining the steady-state solution resulted from the choice of initial heads. For the conditions simulated, the convergence of the iterative solution was extremely slow. However, subsequent testing of the model indicates that the rate of convergence to the solution is problem dependent. For steady-state solutions, the rate of convergence increases with decreases in the value of the leakance of the confining layers. The digital model of the aquifer system was used to estimate mine dewatering rates for proposed mines in the Piceance basin. The results of the model study indicate that, after 30 years of dewatering, the discharge from both mines will be 0.77 cu m/sec, which is supplied by intercepted groundwater discharge and water from storage in the aquifers. About 615 million cu m of water is removed from storage during the 30 years of simulated dewatering. The time steps used in modeling the 30 years of dewatering were increased by a factor of 2 between successive steps. The storage coefficient of the upper aquifer was changed by a factor of 100 when the head at any node declined by a specified amount. The rate of convergence was rapid for all transient problems simulated. (Author's abstract)
W86-03988

EFFECTS OF PONDEROSA PINE TREATMENTS ON WATER YIELD IN ARIZONA,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
M. B. Baker.
Water Resources Research WRERAO, Vol. 22, No. 1, p 67-73, January 1986. 3 fig, 2 tab, 34 ref.

Descriptors: *Water yield, *Arizona, *Ponderosa pines, Overstory removal, Watersheds, Vegetation, Oak trees, Pine trees, Water yield improvement, Agricultural watersheds, Agricultural hydrology.

Annual water yields were determined for three levels of overstory removal and three levels of strip cut with thinning applied on ponderosa pine watersheds. Water yield increases from a completely cleared watershed were statistically significant for 7 years, losing significance after recovery and growth of Gambel oak and herbaceous vegetation. Water yield increases were maintained 6 years after a light overstory removal and 10 years following a heavy overstory removal cut. Significant increases were obtained for 3-4 years following two levels of strip cut with thinning, but were then lost on watersheds with a high percentage of southern exposure or low slopes. Water yield increase remained at a 15% level during the first 6 years on a strip-cut watershed with 60% of its area on northern aspects. (Author's abstract)
W86-04161

QUANTITATIVE DETERMINATION OF PARTIALLY HYDROLYZED POLYACRYLAMIDE POLYMERS IN OIL FIELD PRODUCTION WATER,
Marathon Oil Co., Littleton, CO. Denver Research Center.
For primary bibliographic entry see Field 5A.
W86-04435

STREAM ACIDITY IN SOME AREAS OF WALES IN RELATION TO HISTORICAL TRENDS IN AFFORESTATION AND THE USAGE OF AGRICULTURAL LIMESTONE,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W86-04600

EFFECTS OF FOREST FIRE AND OTHER DISTURBANCES ON WILDERNESS LAKES IN NORTHERN MINNESOTA: 1. LIMNOLOGY,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
S. J. Tarapchak, and H. E. Wright, Jr.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 177-202, April 1986. 12 fig, 4 tab, 31 ref. NSF Grant GB-36213.

Descriptors: *Forest fires, *Lakes, *Environmental effects, *Minnesota, *Limnology, Coniferous forests, Watersheds, Biomass, Phytoplankton, Silica, Nitrogen, Phosphorus, Lake morphology.

Largely virgin forests of the Boundary Water Canoe Area were destroyed by a wildfire in the early spring. As a result, most of the coniferous watersheds of two lakes, in largely granitic terrain, were burned out. The chemical and biological limnology of the two lakes was followed for two years, starting immediately after the fire, and a third lake of comparable size nearby was used as a control. Results show that major ions, silica, and total nitrogen and phosphorus were not significantly different in the three lakes, implying that the runoff from the burned forest did not appreciably affect the two lakes in question. The same conclusion is reached from an analysis of algal biomass and phytoplankton composition. (Lantz-PTT)
W86-04648

4D. Watershed Protection

SEDIMENTATION PROBLEMS IN RIVER BASINS.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 2J.
W86-03973

TOPOGRAPHIC PARTITION OF WATERSHEDS WITH DIGITAL ELEVATION MODELS,
Hunter Coll., New York. Dept. of Geology and Geography.
For primary bibliographic entry see Field 4A.
W86-04157

EFFECTS OF PONDEROSA PINE TREATMENTS ON WATER YIELD IN ARIZONA,
Rocky Mountain Forest and Range Experiment Station, Tempe, AZ.
For primary bibliographic entry see Field 4C.
W86-04161

MUDDY WATER AND AMERICAN AGRICULTURE: HOW TO BEST CONTROL SEDIMENTATION FROM AGRICULTURAL LAND,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
S. B. Lovejoy, J. G. Lee, and D. B. Beasley.
Water Resources Research WRERAO, Vol. 21, No. 8, p 0165-1068, August 1985. p 1065-1068, 1 fig, 1 tab, 7 ref. Cooperative Agreement No. 58-3A75-2-24.

Descriptors: *Agricultural runoff, *Soil erosion, *Sediment transport, *Simulation analysis, *Model studies, Hydrologic models, Land use, Social aspects, Water policy, Nonpoint pollution sources, Erosion control, Water quality, Sedimentation, Agricultural runoff, Environment policy, Cost Analysis, Evaluation.

The role of agricultural sediment in water quality is well documented. While numerous policies have been proposed and initiated, erosion of agricultural soils continues to be a significant problem. The present analysis concentrates on the outcome of several policy alternatives in terms of sediment delivery and project costs. These results are obtained by combining social science investigations of probable farmer behavior under a variety of scenarios with a hydrologic simulation model ANSWERS (Aerial Nonpoint Source Watershed Environment Response Simulation) which predicts the sediment delivery with different land uses. This integration of social science behavioral research with the hydrologic response simulation model provides a framework to assess the environmental effectiveness of alternative policies aimed at reducing sedimentation. While the results obtained so far are preliminary, this approach offers great promise as a tool for federal, state and local conservation agencies in their efforts to efficiently and effectively use their limited resources to reduce soil loss. (Geiger-PTT)
W86-04303

CHANNEL FORM AND STREAM ECOSYSTEM MODELS,
Arkansas Univ., Fayetteville. Dept. of Zoology.
For primary bibliographic entry see Field 6G.
W86-04537

COMMUNITY RESPONSES TO NON-POINT POLLUTION FROM AGRICULTURE,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-04605

5. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification Of Pollutants

MANUAL OF METHODS IN AQUATIC ENVIRONMENT RESEARCH, PART 9: ANALYSES OF METALS AND ORGANOCHLORINES IN FISH.
Food and Agriculture Organization of the United Nations, Rome (Italy).
FAO Fisheries Technical Paper No. 212, 1983. 3 p.

Descriptors: *Pollutant identification, *Chemical analysis, *Aquatic animals, *Metals, *Organochlorine compounds, Spectrophotometry, Fish, Crustaceans, Shellfish, Heavy metals, Chlorine compounds.

This manual describes analytical methods for measuring contamination of fish, crustacea, and bivalves with heavy metals, organochlorines, and methyl mercury. Chapter one describes field sampling, sample storage and preparation of subsamples of biological material for analysis. Chapter two describes the analysis of zinc, copper, lead, and cadmium by flame atomic absorption spectrophotometry (AAS), and mercury and methyl mercury by flameless AAS. It includes descriptions of sample preparation, wet ashing with hydrogen peroxide/nitric acid, and photometric measurement. Chapter three describes the analysis of organochlorines and methyl mercury by gas liquid chromatography. It covers the preparation of columns, extraction and fat isolation, cleanup procedures by sulfuric acid and potassium hydroxide, chromatographic determination, and the calculation of results. (Author's abstract)
W86-03996

FIELD SAMPLING AND PREPARATION OF SUBSAMPLES OF AQUATIC ORGANISMS FOR ANALYSES OF METALS AND ORGANOCHLORINES,
Havsfiskelaboratoriet, Lysekil (Sweden).
B. I. Dybern.
In: Manual of Methods in Aquatic Environment Research, Part 9: Analyses of Metals and Organochlorines in Fish, 1983. p 1-13, 2 fig.

Descriptors: *Pollutant identification, *Sampling, *Aquatic animals, Metals, Organochlorine compounds, Fish, Crustaceans, Shellfish, Mollusks, Mussels, Heavy metals, Chlorine compounds, Sample preparation, Sample preservation, Biological samples.

Guidelines are detailed for field sampling and preparing aquatic organisms for determination of metals and organochlorines. Species for study should be easy to identify, available in sufficient quantities, relatively stationary, and geographically widespread. At least 10, but preferably 15 or 20, individuals of the same age and size should be sampled. Fish of 30-50 cm are easiest to handle and take subsamples from. Samples should be transported as quickly as possible in a moist, but not submerged, condition to the freezing facility. Although animals may be analyzed without freezing, they are much easier to dissect and subsample in the frozen condition. Instructions for labeling and packaging are given for larger animals, smaller animals, and molluscs. Preparation of subsamples is done so that material is available for both metals and organochlorine analysis. Larger fish are fileted; tails of larger crustaceans are separated. For smaller crustaceans muscle pieces of all specimens belonging to the same sample are homogenized together. Soft tissue from molluscs is homogenized first, then subsamples taken. The liver and fatty tissue may also be isolated for analysis. Cleaning procedure for dissection equipment are described. (Cassar - PTT)
W86-03997

ANALYTICAL METHODS FOR MEASURING METALS BY ATOMIC ABSORPTION SPECTROPHOTOMETRY,
Chelsea Coll., London (England). Dept. of Chemistry.
J. Dalziel, and C. Baker.
In: Manual of Methods in Aquatic Environment Research, Part 9: Analyses of Metals and Organochlorines in Fish, 1983. p 14-20, 2 fig, 1 tab.

Descriptors: *Pollutant identification, *Chemical analysis, *Aquatic animals, *Metals, Spectrophotometry, Fish, Crustaceans, Shellfish, Heavy metals, Atomic absorption spectrophotometry, Zinc, Lead, Copper, Cadmium, Mercury.

Procedures for determining metals in samples of fish, shrimp, and oyster are described. The basic method for flame atomic absorption spectrophotometry (AAS) (Zn, Cu, Pb, Cd) involves wet ashing with a mixture of nitric acid and hydrogen peroxide to destroy the bulk of the organic matter, followed by aspiration into the air-acetylene flame. The metals Hg, Se, and As are determined by a modified flame AAS procedure. Total Hg is determined by the cold vapor technique after organic mercury has been determined by the wet ashing and complexing with cysteine. (Cassar - PTT)
W86-03998

ANALYTICAL METHODS FOR MEASURING ORGANOCHLORINES AND METHYL MERCURY BY GAS CHROMATOGRAPHY,
S. Jensen, L. Reutergardh, and B. Jansson.
In: Manual of Methods in Aquatic Environment Research, Part 9: Analyses of Metals and Organochlorines in Fish, 1983. p 21-33, 4 fig, 1 tab.

Descriptors: *Pollutant identification, *Pesticides, *Insecticides, *Mercury, *Organochloride compounds, Chlorinated hydrocarbons, Polychlorinated biphenyls, DDT, DDE, DDD, Hexachlorobenzene, Lindane, Mirex, Aldrin, Gas chromatography, Chromatography, Methyl mercury.

A method for determining organochlorines and methyl mercury by gas chromatography can be used for DDT, DDD, DDE, hexachlorobenzene, some HCH isomers (lindane), polychlorinated biphenyls, and other chlorinated compounds such as aldrin and mirex. The substances are detected by electron capture. (Cassar - PTT)
W86-03999

PORTABLE INSTRUMENT FOR SCREENING SPILL AND SOURCE OIL SAMPLES,
Coast Guard Research and Development Center, Groton, CT.
J. R. Jadamec, G. A. Kleinberg, D. A. Marble, and L. A. Wargo.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 105-109, 7 fig, 2 tab, 5 ref.

Descriptors: *Oil Spills, *Pollutant identification, *Oil, *Spectroscopy, Spectral analysis, Oily water, Oil pollution, Field Identification, Luminescence Monitor.

The U.S. Coast Guard Research and Development Center recently completed a laboratory and field evaluation of a portable (battery powered) Field Identification Luminescence Monitor (FILM) developed for oil spill identification. This instrument, a simplified fluorescence spectrometer, features high resolution, portability, operational simplicity, and sample-handling versatility. It is designed to record the fluorescence emission spectrum of oil from 280 to 650 nanometers (nm) directly on Polaroid film for rapid comparisons of spill and suspected source samples directly at the spill site. Samples can be in the form of neat oils, solutions of oil in water, or as deposits on various substrates. Laboratory and field tests indicate that use of this instrument by pollution investigators both reduces the number of samples requiring laboratory analysis and increases the probability that the correct source has been sampled at or in the vicinity of the spill site. This system also can detect other fluorescing materials such as industrial solvents, specific hazardous chemicals, and polyaromatic hydrocarbons. (Author's abstract)
W86-04015

BIOLOGICAL MONITORING OF THE FORTIES OILFIELD (NORTH SEA),
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
J. P. Hartley, and J. Ferbrache.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983. p 407-414, 6 fig, 7 tab, 24 ref.

Descriptors: *Monitoring, *Biological properties, *Oil, *Bioindicators, *Environmental effects, Ecological effects, Hydrocarbons, North Sea.

The Forties Oilfield (the largest in the U.K. sector of the North Sea) has been in production since September 1975. In June 1975, a quantitative survey of the benthic sediments and fauna over the area as made at the start of an environmental monitoring program for the field. The results of a repeat survey carried out after three years of pro-

duction have been reported by Hartley. This paper presents data from a third similar survey in June 1981 and compares the findings with those of the earlier surveys. The benthic fauna of the Forties field is rich and diverse and qualitatively corresponded well in 1981 to previous descriptions. Naturally occurring gradients in both the sediment type and fauna are a feature of this area. Changes in the densities of certain species were noted at some sites in 1981, including increases in certain opportunistic forms. Although no areas of biological effect could be delineated around the four production platforms, the industrial activity in the field may be implicated in the changes found at several stations. The hydrocarbon content of the sediments was low and, with one possible exception, did not appear related to the biological changes noted. The results to date suggest that offshore oilfield in deep water, developed using water-based drill fluids, present relatively few biological problems in the short term. Since no major biological effects have been found after six years of drilling and production, a reduced program of monitoring is recommended to maintain biological surveillance during the life of the field. (Author's abstract)
W86-04033

NATURAL RESOURCES DAMAGE ASSESSMENT STUDY: THE IXTOC I BLOWOUT,
Energy Resources Co., Inc., Cambridge, MA.
For primary bibliographic entry see Field 5C.
W86-04040

SORPTION KINETICS OF TOXIC AND HAZARDOUS ORGANIC SUBSTANCES ON NEW JERSEY COASTAL PLAIN AQUIFER SOLIDS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
For primary bibliographic entry see Field 5B.
W86-04052

DELINEATING GROUNDWATER CONTAMINATION BY HOUSEHOLD WASTEWATER,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
D. Mitchell, and R. Ashworth.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 129-131, 2 fig, 2 tab, 7 ref.

Descriptors: *Groundwater pollution, *Wastewater pollution, *Domestic wastes, Wastewater, Fluorescent whitening agents, Soil columns, Leachates, Wells, Springs, Coliforms, Organic carbon.

A laboratory investigation and a confirming field study has been completed whereby groundwater contaminated by inadequately treated septic tank effluent can be easily delineated from other contaminating sources. The methodology involves fluorescent whitening agents (FWA) contained in commercial household laundry products found in virtually all household wastewaters; most domestic wastewater has between 0.2 and 0.4 mg/FWA. A laboratory study of leachate from eight unsaturated 4 inch diameter soil columns treating septic tank effluents demonstrated a good correlation between FWA concentration and leachate water quality. Leachate from lysimeters in two different existing septic tank leachfields were analyzed confirming the relationship between FWA concentrations and the septic tank leachfield water quality. No FWA was detected in well purified leachate but levels as high as 0.05 mg/l were found in leachates with high total organic carbon and high total coliform bacteria concentrations. Several contaminated wells and springs were examined, some with as much as 80 fecal coliform bacteria per 100 ml and total organic carbon in excess of 100 mg/l found free of FWA indicating agricultural or commercial sources no household wastewater. Other similarly contaminated did not contain FWA indicating faulty septic tank systems as the sources. (Author's abstract)
W86-04076

VIRAL AND BACTERIAL CONTAMINATION OF GROUNDWATER BY ON-SITE WASTEWATER TREATMENT SYSTEMS IN SANDY COASTAL SOILS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5B.
W86-04077

DEVELOPING INFORMATION ON ALDICARB LEVELS IN LONG ISLAND GROUNDWATER,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
For primary bibliographic entry see Field 5B.
W86-04080

COMBINED USE OF GENOTOXICITY AND WHOLE EMBRYO TERATOGENICITY SCREENING ASSAYS IN PREDICTING TERATOGENIC RISKS,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5C.
W86-04088

SAMPLING ANALYTICAL CONCERNS IN VOLATILE ORGANIC CONTAMINANT STUDIES,
Illinois State Water Survey Div., Champaign.
M. J. Barcelona, J. A. Helfrich, and J. P. Gibb.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 181-183, 6 tab, 7 ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Chemical analysis, *Water sampling, Sampling, Groundwater movement, Groundwater.

The choices of sampling and analytical methodologies for groundwater and subsurface processes research are frequently made from the standpoint of convenience, expediency or faith. Clearly, an optimal combination of sampling and analysis procedures must be selected to minimize errors involved in the determination of the chemical constituents of interest. Systematic errors (bias) and poor precision severely limit our understanding of net transport processes as well as the relative importance of physical, chemical or biological factors in controlling such processes. Volatile dissolved compounds are of particular interest in groundwater processes research, since they may provide valuable indicators of plume migration, inter-media transfer, solution geochemistry and microbial activity. A systematic evaluation of groundwater sampling mechanisms has been conducted in our laboratories to determine the sources and magnitude of sample collection errors. The determination of common solution parameters was unaffected by most sampling mechanisms with the exception of the peristaltic (suction) pump. The accuracy of overall determinations of dissolved gases (O2, CH4) and trihalomethane compounds can be significantly worsened by suction and gas displacement mechanisms. In general, mechanism related bias and imprecision are the result of degassing. Sampling error due to the mechanism of collection alone can exceed the errors involved in analytical procedures. (Author's abstraact)
W86-04090

USE OF THE ELECTRICAL POTENTIAL OF CELL MEMBRANES TO RAPIDLY ASSESS POTENTIAL TOXICANTS,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
J. T. Blankmeyer.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 184-185, 1 tab, 6 ref.

Descriptors: *Electrical properties, *Cell membranes, *Toxicity, *Bioindicators, Amphibians, In-vitro tests, Naphthalene, Polycyclic aromatic hydrocarbons, Biological analysis, Water pollution effects.

Isolated frog skin retains most of its in-vivo function for 24 hours. One of the in-vitro functions is to actively transport Na from the pondside of the skin to the blood-side. Since many toxicants are lipid-soluble or affect the characteristics of membranes, we have chosen to test if the skin is a useful assay system for rapid determinations of effects of membrane-active toxicants. Naphthalene was used to assess the feasibility of the system to detect the effect of toxicants on the active transport parameters of epithelia vertebrates. The Potential Difference (PD) and Short Circuit Current (SCC) were used as indicators of the net movement of Sodium, activity of the Sodium-Potassium pump, and the conductivity of the para-cellular leakage pathways. Naphthalene was found to alter the membrane potential and short-circuit current of the frog skin with a linear relationship. Using naphthalene concentrations in the 1 to 10 mg/L range, naphthalene was found to cause rapid increase in the Short Circuit Current, the measure of Active Sodium Transport. It is concluded that the Short Circuit Current is a viable assay method for rapid determination of toxicant effects. (Author's abstract)
W86-04091

IDENTIFICATION OF SUBSURFACE BRINES USING STATISTICAL TECHNIQUE,
National Inst. of Hydrology, Roorkee (India).
A. G. Chachadi, and B. Soni.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 191-193, 4 fig, 7 ref.

Descriptors: *Statistical analysis, *Subsurface water, *Saline water, Statistical methods, Groundwater quality, Chemical analysis, Chloride, Ion exchange, Aquifers, Groundwater.

Statistical techniques have been successfully used to sort out the hydrogeologic process-response relationships from commonly collected groundwater quality data. The purpose of this study is to demonstrate the usefulness of principal components analysis, a multivariate statistical technique, as a tool for mapping areas of distinct chemical features. The chemical analysis data of fifty-four groundwater samples have been used. The locations of the groundwater samples are distributed over an area of about 500 sq. km. in the Gangetic plain. Three components which represent different chemical processes have been identified, and their relative areal impacts have been determined. These components are, (1) localized concentration of chloride and T.D.S. due to scarce precipitation, high rate of evapotranspiration, and convergence of the groundwater flow; (2) dissolution and ion exchange in the semipermeable layer that overlies portions of the aquifer; and (3) regional dissolution of carbonaceous formation. The scores of principal components have been used to identify the saline water areas, and to distinguish the saline and non-saline water samples. A conceptual model has been proposed to represent the physical system. (Author's abstract)
W86-04093

NEW METHODOLOGY FOR ASSESSING MUTAGENICITY OF WATER AND WATER RELATED SEDIMENTS,
Missouri Univ.-Columbia. Environmental Trace Substances Research Center.
W. R. Lower, A. G. Underbrink, A. F. Yanets, K. Roberts, and T. K. Ranney.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 194-196, 13 ref.

Descriptors: *Water pollution effects, *Toxicity, *Sediments, *Biological analysis, *Water Quality, Water pollution, Chemical analysis, Tradescantia, Water analysis.

Methodology not included in the EPA list, 'Ambient Water Quality Criteria,' is available for the rapid and cost-efficient assay of mutagens and physiologically detrimental agents which occur in waters, water related sediments and sludges. Both

mutational and physiological effects resulting from such agents may be investigated simultaneously in the plant Tradescantia. There are three tests which involve separate end points: (1) the stamen hair test assesses somatic mutations at a single locus; (2) the micronucleus test is a measure of a germinal mutation caused by chromosome breakage or meiotic disturbances in pollen mother cells; and (3) variable fluorescence is a measure of perturbation in the electron transport system of photosynthesis. All three tests are suitable for both short term and chronic exposures and for both field and laboratory studies. (Author's abstract)
W86-04094

MINIMIZING PROBLEMS CAUSED BY UNEQUAL DEVELOPMENT OF BIOLOGICAL ACTIVITY WITHIN COLUMN MICROCOSMS USED TO PREDICT THE FATE OF POLLUTANTS IN SUBSURFACE MATERIALS,
Robert S. Kerr Environmental Research Lab., Ada, OK.
G. D. Miller, G. M. Deeley, J. C. Chang, and J. T. Wilson.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 197-198, 2 fig, 2 ref.

Descriptors: *Microcosms, *Subsurface waters, *Groundwater movement, *Organic compounds, *Bioindicators, Phenol, 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, Groundwater pollution, Groundwater.

Microcosms are useful tools to predict the fate of chemical substances in natural systems. They can reveal the potential for occurrence of a particular process in the natural system of interest, and under appropriate circumstances can generate data on the kinetics of the process that can be used to model the real system. In order to generate data that could be used for projections of kinetics, we constructed a microcosm that was as faithful as possible to the subsurface environment. Authentic subsurface material was collected in a way that avoided microbial contamination, then packed into sterile Teflon and glass columns. The material was exposed under aerobic conditions to concentrations of phenol; 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, and 4-nitrophenol in the range of 10-20 microgram/liter. The chemicals were dissolved in sterilized ground water from the same layer of sand used to construct the microcosms. The flow rate in the columns was slow, about 2 cm per day, to simulate ground water flow. After two months, a zone of intense biological activity developed at the head of the columns. This rendered the microcosms useless for any sort of kinetic analysis because it was impossible to determine the width of the active zone, and thus the residence time of the pollutants in that zone. To minimize these problems, new microcosms were constructed, and the solution of chemicals was forced through them as rapidly as possible until the organic chemicals broke through in the column effluent. Then flow through the microcosms was stopped, except for the minimum volume needed for chemical analysis. Upon subsequent incubation, all the material in the columns experienced the same concentration of the pollutants, and the columns as a whole responded to the effects of the pollutants. (Author's abstract)
W86-04095

ABUNDANCE, HETEROTROPHIC ACTIVITY AND TAXONOMY OF BACTERIA IN A STREAM SUBJECT TO POLLUTION BY CHLOROPHENOLS, NITROPHENOLS AND PHENOXYALKANOIC ACIDS,
Hull Univ. (England). Dept. of Plant Biology.
For primary bibliographic entry see Field 5C.
W86-04113

COMPARISON OF ALGAL ASSAY SYSTEMS FOR DETECTING WATERBORNE HERBICIDES AND METALS,
Montana State Univ., Bozeman. Dept. of Microbiology.
S. C. Turbak, S. B. Olson, and G. A. McFeters.
Water Research WATRAG, Vol. 20, No. 1, p 91-96, January 1986. 1 fig, 3 tab, 38 ref. EPA Grant No. R805383.

Descriptors: *Algal assays, *Herbicides, *Trace metals, Water pollution, Bottle test, Oxygen Evolution Assay, Bioassay, Water pollution effects, Toxicity, Selenastrum, Atrazine, 2,4,D-glycophosphate, Cadmium, Copper, Chromium, Silver, Zinc.

The EPA Bottle Test was compared to a short-term algal bioassay method (Oxygen Evolution Assay) for detecting waterborne herbicides and metals. Although the Bottle Test proved to be a more sensitive assay system, the responses of the two bioassays correlated well. The Oxygen Evolution Assay may be useful as a rapid preliminary screening method for determining which chemicals should undergo further testing. In both bioassays, differences were observed in the results of experiments conducted in the standard algal growth medium and in nutrient-enriched water samples, suggesting that water chemistry plays an important role in the determination of specific toxicity thresholds for algae. (Author's abstract)
W86-04114

COMPARISON OF POSITIVELY CHARGED MEMBRANE FILTERS AND THEIR USE IN CONCENTRATING BACTERIOPHAGES IN WATER,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
P. A. Shields, T. L. Ling, V. Tjatha, D. O. Shah, and S. R. Farrah.
Water Research WATRAG, Vol. 20, No. 2, p 145-151, February 1986. 4 fig, 5 tab, 22 ref.

Descriptors: *Bacteriophage, *Positively charged membrane filters, *Adsorption, *Elution, Membrane filters, Viruses, Bacteriophage concentration, Natural waters.

Virus adsorption-elution studies and physical measurements were performed on four electropositive membrane filters (Virosorb 1MDS, Posidyne N66, Zeta plus C-30, and Seitz S). The relative hydrophobicity of the membrane filters was determined by measuring the contact angle of carbon tetrachloride with the filters and by measuring the rate of rise of hexadecane and water in the filters. Viruses adsorbed to the least hydrophobic filter (Virosorb 1MDS) could be eluted by using a solution of salt (NaCl or NaEDTA) alone to disrupt electrostatic interactions between the viruses and the filter. Solutions containing both salt and detergent were required to elute virus adsorbed to two of the more hydrophobic filters (Posidyne N66 and Zeta plus C-30), indicating that both electrostatic and hydrophobic interactions were responsible for viral adsorption to these filters. A two-step procedure for recovering bacteriophages from water was developed that employed different filters for each step. Virosorb 1MDS was used to adsorb indigenous phage in water samples. Adsorbed virus could be recovered by treating the filter with a solution of 1.0 M NaCl. Phages in this solution could be further concentrated by a second adsorption-elution step that used Seitz S filters. (Author's abstract)
W86-04121

VOLATILE OZONIZATION PRODUCTS OF AQUEOUS HUMIC MATERIAL,
Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 5F.
W86-04122

ACTION OF OZONE ON METHYL OCTADEC-9-ENOATE IN POLAR SOLVENTS: A MODEL FOR AQUEOUS OZONIZATION OF ORGANIC COMPOUNDS,
Bristol Univ. (England). Organic Geochemistry Unit.
For primary bibliographic entry see Field 5F.
W86-04123

DESCRIPTION OF THE AGGREGATION PROPERTIES OF AQUATIC PEDOGENIC FULVIC ACIDS: COMBINING PHYSICO-CHEMICAL DATA AND MICROSCOPICAL OBSERVATIONS,
National Water Research Inst., Burlington (Ontario). Aquatic Ecology Div.
For primary bibliographic entry see Field 2K.
W86-04125

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - I: OZONE CONSUMPTION AND OZONATION PRODUCTS,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5D.
W86-04126

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - II: KINETIC STUDIES OF THE INITIAL REACTION STEP,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5D.
W86-04127

SIMULTANEOUS DETERMINATION OF TOTAL ORGANIC CARBON AND TOTAL NITROGEN IN WATERS BY PYROLYSIS - GAS CHROMATOGRAPHY - MASS SPECTROMETRY,
Government Industrial Research Inst., Nagoya (Japan).
K. Nakajima.
Water Research WATRAG, Vol. 20, No. 2, P 233-235, February 1986. 2 fig, 2 tab, 4 ref.

Descriptors: *Total organic carbon, *Total nitrogen, *Pyrolysis, *Gas chromatography, *Mass spectrometry, Water sampling, Simultaneous determination.

An apparatus with a pyrolysis unit, gas chromatograph and quadrupole mass spectrometer was assembled for the simultaneous deermination of total organic carbon (TOC) and total nitrogen (TN) in waters. The mass numbers used for the determination of TOC and TN were m/e 44 (CO_2^+) and m/e 30 (NO^+), respectively. The short-term stability (relative standard deviation) was 3.3% for TOC, and 5.0% for TN. The detection limits were 0.076 micrograms/m for TOC and 1.3 micrograms/m for TN. TOC and TN in water samples were determined by this method, and the results agreed well with those obtained by a combustion-infrared method for TOC and a combustion-infrared method for TOC and a combustion-coulometric method for TN. (Author's abstract)
W86-04129

INVESTIGATIONS INTO THE SCOPE AND LIMITATIONS OF THE BISMUTH ACTIVE SUBSTANCES PROCEDURE (WICKBOLD) FOR THE DETERMINATION OF NONIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES,
Unilever Research Port Sunlight Lab. (England).
J. Walters, J. T. Garrigan, and A. M. Paulson.
Water Research WATRAG, Vol. 20, No. 2, p 247-253, February 1986. 1 fig, 5 tab, 8 ref.

Descriptors: *Nonionic surfactants, *Raw wastewater, *Bismuth active substances, Monitoring, Wickbold procedure, Chemical analysis, England, Wastewater treatment.

In Europe, the bismuth active substances (BiAS) procedure of Wickbold has been officially adopted as the means for determining alkoxylated nonionic surfactants - particularly in sewage. The scope and limitations of the BiAS procedure in this application have been demonstrated in a series of experiments in which the influence of procedural variables such as sample pretreatment, number and duration of solvent sublation steps and the ion-exchange clean-up of BiAS extracts prior to their analysis, have been examined. As a result, it is recommended that when BiAS procedures are used to determine nonionic surfactants in environmental samples, whole samples should be used and

the procedure should include four 10-min sublation steps and a cation/anion exchange clean-up of the sublation extracts. BiAS procedures in which the variables are not suitably chosen can result in BiAS levels being more seriously under-estimated in raw-sewage samples than in samples of the corresponding effluents. Their use could therefore lead to the belief that removal of nonionic surfactant by the sewage treatment process is less efficient than it is in practice. (Lantz-PTT)
W86-04131

MONITORING STATISTICS,
National Research Council, Washington, DC.
G. E. Schweitzer, and S. C. Black.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1026-1030, November 1985. 3 fig, 1 tab, 15 ref.

Descriptors: *Statistical methods, *Statistical models, *Data interpretation, *Monitoring, *Groundwater pollution, *Statistical analysis, Data collection, Sampling, Design criteria, Project planning, Resource Conservation and Recovery Act, Love Canal, New York.

Until recently, only limited effort has been directed toward the statistical aspects of designing procedures for sampling under field conditions. An individual sample is required to be representative of the environmental condition it is intended to define. Since soil and groundwater contamination are three-dimensional problems, the size of the individual sample and the number and location of the samples are critical in any attempt to portray environmental conditions. The use of statistics now plays a greater role in the design of sampling programs because of groundwater regulations promulgated by EPA under the Resource Conservation and Recovery Act. The report of an ACS-EPA workshop on environmental sampling for hazardous wastes provides an overview of current designs of field sampling programs. Two of the major questions that arise when risk assessments are conducted at hazardous waste sites relate to the level and extent of contamination and to the way in which contamination compares with background levels. The EPA monitoring programs at Love Canal and the Dallas Lead Study illustrate how statistics have been used to assess monitoring data in addressing these questions. To improve the statistical techniques for guiding the design of monitoring programs, monitoring data must be combined with factors that are based on professional judgement about the likely subsurface behavior of contaminants. Methods need to be developed to use information obtained from limited or small sample sets with more confidence. Statistical analyses of long-term monitoring under varying background conditions also should be examined. (Geiger - PTT)
W86-04137

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
For primary bibliographic entry see Field 5C.
W86-04143

MONITORING OF ENTEROVIRUSES IN THE WATER SUPPLY OF BARCELONA FROM SURFACE WATER OF THE RIVER LLOBREGAT (CONTROLE D'ENTEROVIRUS DAS L'APPROVISIONNEMENT A BARCELONE PAR L'EAU DE SURFACE DU FLEUVE LLOBREGAT),
Sociedad General de Aguas de Barcelona (Spain).
For primary bibliographic entry see Field 5G.
W86-04153

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 1. ESTIMATION TECHNIQUES,
Geological Survey, Reston, VA.
R. J. Gilliom, and D. R. Helsel.
Water Resources Research WRERAO, Vol. 22, No. 2, p 135-146, February 1986. 6 fig, 6 tab, 9 ref, 1 append.

Descriptors: *Trace levels, *Water quality, *Distribution parameters, *Estimating, Metals, Organic compounds, Water pollution, *Statistical analysis, Monte Carlo method, Logarithmic distribution, Regression analysis.

A recurring difficulty encountered in investigations of many metals and organic contaminants in ambient waters is that a substantial portion of water sample concentrations are below limits of detection established by analytical laboratories. Several methods were evaluated for estimating distributional parameters for such censored data sets using only uncensored observations. Their reliabilities were evaluated by a Monte Carlo experiment in which small samples were generated from a wide range of parent distribution and censored at varying levels. Eight methods were used to estimate the mean, standard deviation, median, and interquartile range. Criteria were developed, based on the distribution of uncensored observations, for determining the best-performing parameter estimation method for any particular data set. The most robust method for minimizing error in censored-sample estimates of the four distributional parameters over all simulation conditions was the log-probability regression method. With this method, censored observations are assumed to follow the zero-to-censoring level portion of a lognormal distribution obtained by a least squares regression between logarithms of uncensored concentration observations and their z scores. When method performance was separately evaluated for each distributional parameter over all simulation conditions, the log-probability regression method still had the smallest errors for the mean and standard deviation, but the lognormal maximum likelihood method had the smallest errors for the median and interquartile range. When data sets were classified prior to parameter estimation into groups reflecting their probable parent distributions, the ranking of estimation methods was similar, but the accuracy of error estimates was markedly improved over those without classification. (see also W86-04769) (Author's abstract)
W86-04168

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 2. VERIFICATION AND APPLICATIONS,
Geological Survey, Reston, VA.
D. R. Helsel, and R. J. Gilliom.
Water Resources Research WRERAO, Vol. 22, No. 2, p 147-155, February 1986. 1 fig, 9 tab, 4 ref, append.

Descriptors: *Trace levels, *Water quality, *Distribution parameters, *Estimating, *Statistical analysis, *Verification, Root-mean-square, Probability regression, Simulation analysis, Water quality assessment.

Estimates of distributional parameters (mean, standard deviation, median, interquartile range) are often desired for data sets containing censored observations. Eight methods for estimating these parameters have been evaluated using Monte Carlo simulations. To verify those findings, the same methods are now applied to actual water quality data. The best method (lowest root-mean-squared error (rmse)) over all parameters, sample sizes, and censoring levels is log probability regression (LR), the method found best in the Monte Carlo simulations. Best methods for estimating moment or percentile parameters separately are also identical to the simulations. Reliability of these estimates can be expressed as confidence intervals using rmse and bias values taken from the simulation results. Finally, a new simulation study shows that best methods for estimating uncensored sample statistics from censored data sets are identical to those for estimating population parameters. Thus this study and the companion study by Gilliom and Helsel form the basis for making the best possible estimates of either population parameters or sample statistics from censored water quality data, and for assessments of their reliability. (see also W86-04168) (Author's abstract)
W86-04169

CHLORINATED CARBOXYLIC ACIDS IN SOFTWOOD KRAFT PULP SPENT BLEACH LIQUORS,
Svenska Traeforskningsinstitutet, Stockholm.
K. Lindstrom, and F. Osterberg.
Environmental Science and Technology, Vol. 20, No. 2, p 133-138, February 1986. 5 fig, 1 tab, 26 ref.

Descriptors: *Chlorinated carboxylic acids, *Pulp wastes, *Softwoods, Bleaching wastes, Pulp and paper industry, Ultrafiltration, Gas chromatography, Mass spectrometry, Chlorine, Alkali extraction.

Characterization and identification of the chlorinated acidic low molecular matter of kraft pulp mill bleach plant effluents have been carried out. Characterization was performed by ultrafiltration followed by ether extraction and determination of the organically bound chlorine in the various fractions. Identification was performed by capillary gas chromatography-mass spectrometry after isolation and methylation of the acidic components. This study concludes that: (1)The chlorine (C) and alkali extraction (E) stage spent liquors contain about 300 and 30 g/ton of pulp of chlorinated low molecular and ether-extractable acids, respectively (calculated as OgCL); (2) About 30% (100 g/ton) of the ether-extractable acidic OgCl in the C-stage and about 60% (18 g/ton) in the E-stage liquors have been identified; (3) Chlorinated acetic acids are by far the most predominating chloro organic acids so far identified; (4) A new series of chlorinated keto acids has been identified; and, (5) Totally 31 carboxylic acids have tentatively been identified. (Lantz-PTT)
W86-04224

COMPARISON OF METHODS FOR THE CONCENTRATION OF SUSPENDED SEDIMENT IN RIVER WATER FOR SUBSEQUENT CHEMICAL ANALYSIS,
Geological Survey, Doraville, GA. Water Resources Div.
A. J. Horowitz.
Environmental Science and Technology, Vol. 20, No. 2, p 155-160, February 1986. 2 tab, 21 ref.

Descriptors: *Suspended sediments, *Rivers, *Chemical analysis, Centrifugation, Sedimentation, Backflush filtration, Trace metals.

Centrifugation, settling with centrifugation, and backflush-filtration procedures have been tested for the concentration of suspended sediment from water for subsequent trace metal analysis. Either of the first two procedures is comparable with in-line filtration and can be carried out precisely, accurately, and with a facility that makes the procedures amenable to large-scale sampling and analysis programs. There is less potential for post-sampling aiteration of suspended sediment-associated metal concentrations with the centrifugation procedure because sample stabilization is accomplished more rapidly than with the settling and centrifugation procedure. Sample preservation can be achieved by chilling. Suspended sediment associated metal levels can best be determined by direct analysis but can also be estimated from the difference between a set of unfiltered-digested and filtered subsamples. However, when suspended sediment concentrations (<150 mg/L) or trace metal levels are low, the direct analysis approach makes quantitation more accurate and precise and can be accomplished with simpler analytical procedures. (Lantz-PTT)
W86-04225

INSIGHT INTO THE MECHANISM OF ACCUMULATION OF ARSENATE AND PHOSPHATE IN HYDRO LAKE SEDIMENTS BY MEASURING THE RATE OF DISSOLUTION WITH ETHYLENEDIAMINETETRAACETIC ACID,
Auckland Univ. (New Zealand). Dept. of Chemistry.

For primary bibliographic entry see Field 5B.
W86-04228

HOLDING EFFECTS ON COLIFORM ENUMERATION IN DRINKING WATER SAMPLES,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
For primary bibliographic entry see Field 5F.
W86-04233

SELECTIVE MEDIUM FOR THE ISOLATION OF OPPORTUNISTIC FLAVOBACTERIA FROM POTABLE WATER,
National Hansen's Disease Center, Carville, LA.
For primary bibliographic entry see Field 5F.
W86-04239

SELECTIVE DETECTION AND ENUMERATION OF FECAL COLIFORMS IN WATER BY POTENTIOMETRIC MEASUREMENT OF LIPOIC ACID REDUCTION,
Laboratoire Municipal d'Hygiene, Le Havre (France).
T. Jouenne, G. A. Junter, and G. Charriere.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1208-1212, Nov. 1985. 2 fig, 4 tab, 8 ref. French National Institutes of Health and Medical Research grants 820128 and 830112.

Descriptors: *Coliforms, *Bacterial Analysis, *Water Analysis, Drinking Water, Groundwater, Aquifers, Secondary Wastewater, Surface Water, Escherichia coli, Enterobacter, Klebsiella, Citrobacter.

Water samples of various origins were inoculated into a specific coliform-selective lactose broth provided with lipoic (thiotic) acid, and the time evolution of the redox potential of the cultures was monitored during incubation at 41 C by use of gold versus reference electrodes. Positive potential-time responses, i.e., 100-mV potential shifts recorded within 20 h of inoculation, were related to the initial number of fecal coliforms in the broth determined by control enumeration techniques, and the organisms responsible were isolated and identified by conventional procedures. A total of 30 samples of wastewater, 38 of surface water, 533 of groundwater, and 110 of drinking water were tested successively. A total of 240 natural water samples including 172 groundwater samples, and 1 drinking water sample were positive in the potentiometric test. Most (92%) of detection times were shorter than 15 h, and 96% of these could be attributed to Escherichia coli. Fifteen hours corresponded to the limit for detecting 1 E. coli cell/100 ml of water. About 78% of the potentiometric responses occurring after 15 h were induced by fecal coliforms other than E. coli (Enterobacter cloacae, Klebsiella pneumoniae, and Citrobacter freundii). Calibration curves relating detection times shorter than 15 h to fecal coliform concentrations were constructed for the natural water samples tested. There were minor variations in the average growth rate of the organisms in relation to the contamination level of the water tested. The number of false-positive samples in the potentiometric test was equivalent to that of false-negative samples (groundwater or drinking water). (Author's abstract)
W86-04252

USE OF IMMUNOFLUORESCENCE AND PHASE-CONTRAST MICROSCOPY FOR DETECTION AND IDENTIFICATION OF GIARDIA CYSTS IN WATER SAMPLES,
Health Effects Research Lab., Cincinnati, OH.
J. F. Sauch.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1434-1438, December 1985. 2 fig, 1 tab, 10 ref.

Descriptors: *Giardia, *Microscopic Analysis, *Water Analysis, Pathogens, Fluorescence, Surface Water, Water Conveyance, Human Disease.

A method was developed in which indirect immunofluorescence and phase-contrast microscopy are used for rapid detection and identification of Giardia cysts in raw and finished water supplies. When anti-Giardia cyst antiserum and fluorescein conjugate were applied to known Giardia cysts on membrane filters, the cysts fluoresced bright green when they were illuminated by UV light. This procedure permitted individual cysts to be quickly located even in samples heavily contaminated with other microorganisms and debris. The identity of presumptive Giardia cysts located in this way could then be confirmed by observing characteristic internal morphological features with phase-contrast microscopy. With this method, Giardia cysts were detected and their identities were confirmed in 14/24 samples taken from raw water and in 6/22 finished surface water supplies during several outbreaks in Pennsylvania. This immunofluorescence method is faster and easier than direct phase-contrast microscopy because of the specific high-contrast image produced. (Author's abstract)
W86-04255

EVALUATION OF METHODS FOR CONCENTRATING HEPATITIS A VIRUS FROM DRINKING WATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
M. D. Sobsey, S. E. Oglesbee, and D. A. Wait.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1457-1463, December 1985. 6 tab, 30 ref. EPA CR-810311.

Descriptors: *Drinking Water, *Enteric Viruses, *Water Analysis, Microbiological Studies, Pathogens.

In this study, widely used concentration methods involving adsorption to and subsequent elution from microporous filters followed by organic flocculation were evaluated for their ability to recover hepatitis A virus (HAV) from seeded drinking water. Cell culture-adapted HAV (strain HM-175) in seeded tapwater was efficiently adsorbed by both electronegative (Filterite) and electropositive (Virosorb 1MDS) filters at pH and ionic conditions previously used for other enteric viruses. Adsorbed HAV was efficiently eluted from these filters by beef extract eluents at pH 9.5. Eluted HAV was further concentrated efficiently by acid precipitation (organic flocculation) of eluents containing beef extract made from powdered, but not paste, sources. By using optimum adsorption conditions for each type of filter, HAV was concentrated >100 fold from samples of seeded tapwater, with about 50% recovery of the initial infectious virus added to the samples. The ability to recover and quantify HAV in contaminated drinking water with conventional microporous filter and organic flocculation methods should prove useful in further studies to determine the role of drinking water in HAV transmission. (Peters-PTT)
W86-04256

CONCENTRATION OF VIRUSES FROM WATER BY USING CELLULOSE FILTERS MODIFIED BY IN SITU PRECIPITATION OF FERRIC AND ALUMINUM HYDROXIDES,
Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
S. R. Farrah, and D. R. Preston.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1502-1504, December 1985. 3 tab, 16 Ref. EPA R810126-01-0.

Descriptors: *Viruses, *Water Analysis, *Microbiological Studies, *Filtration, Bacteriophage, Coxsackie Virus, Polio Virus, Adsorption, Elution, Enterovirus, Echovirus, Pathogens.

Untreated cellulose filters adsorbed only small amounts of poliovirus 1, echovirus 5, coxsackievirus B5, or bacteriophage MS2 that were added to tap water or to solutions of imidazole-glycine buffer at pH 5 to 7. Modification of filters by in situ flocculation of ferric and aluminum hydroxides greatly increased the ability of the filters to adsorb viruses. Viruses adsorbed to the modified filters could be recovered by treating the filters with 3% beef extract (pH 9.5). More than 60% of the enteroviruses and >55% of the MS2 added to tap water or buffer could be recovered in the beef extract eluate. These results indicate that in situ precipitation of metallic salts may permit the production of relatively simple and inexpensive filters for recovering viruses from water. (Peters-PTT)
W86-04258

DEVELOPMENT OF METHODS TO MEASURE VIRUS INACTIVATION IN FRESH WATERS,
James N. Gamble Inst. of Medical Research, Cincinnati, OH.
R. L. Ward, and P. E. Winston.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1144-1148, November 1985. 5 fig, 1 tab, 7 ref. EPA R811183.

Descriptors: *Enteroviruses, *Virus Inactivation, *Water Analysis, Natural Waters, Polio Virus, Antibiotics.

The study concerns the identification and correction of deficiencies in methods used to measure inactivation rates of entire viruses seeded into environmental waters. Viable microorganisms in an environmental water sample increased greatly after addition of small amounts of nutrients normally present in the unpurified seed virus preparation. This burst of microbial growth was not observed after seeding the water with purified virus. The use of radioactively labeled poliovirus revealed that high percentages of virus particles, sometimes >99%, were lost through adherence to containers, especially in less turbid waters. This effect was partially overcome by the use of polypropylene containers and by the absence of movement during incubation. Adherence to containers clearly demonstrated the need for labeled viruses to monitor losses in this type of study. Loss of viral infectivity in samples found to occur during freezing was avoided by addition of broth. Finally, microbial contamination of the cell cultures during infectivity assays was overcome by the use of gentamicin and increased concentrations of penicillin, streptomycin, and amphotericin B. (Author's abstract)
W86-04263

MODELING EXPOSURE ROUTES TO MAN OF TRACE METALS ASSOCIATED WITH ACID PRECIPITATION,
Monitoring and Assessment Research Centre, London (England).
For primary bibliographic entry see Field 5B.
W86-04266

INFLUENCE OF ACID RAIN UPON WATER PLUMBOSOLVENCY,
Glasgow Univ. (Scotland). Dept. of Medicine.
For primary bibliographic entry see Field 5C.
W86-04270

HEALTH RISKS FROM ACID RAIN: A CANADIAN PERSPECTIVE,
Environmental Health Directorate, Ottawa (Ontario).
For primary bibliographic entry see Field 5C.
W86-04272

TRACE ANALYSIS OF THIOSULFATE IN CORRODED CONCRETE SEWERS BY DIFFERENTIAL-PULSE-ANODIC-STRIPPING VOLTAMMETRY,
Hamburg Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie.
For primary bibliographic entry see Field 5D.
W86-04284

STRONTIUM AND ITS ISOTOPES IN CANADIAN RIVERS: FLUXES AND GLOBAL IMPLICATIONS,
Ottawa Univ. (Ontario). Dept. of Geology.
For primary bibliographic entry see Field 2K.
W86-04348

ACUTE METAL TOXICOLOGY OF OLFACTION IN COHO SALMON: BEHAVIOR, RE-

CEPTORS, AND ODOR-METAL COMPLEXATION,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-04366

ANALYSE THE HYDROCARBONS IN LIQUID REFINERY WASTES,
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
W. Kalbfus.
Hydrocarbon Processing IHPRBS, Vol. 65, No. 1, p 77-78, January 1986.

Descriptors: *Aliphatic hydrocarbons, *Effluent streams, *Oil refineries, *Oily water, *Aromatic hydrocarbons, Catalytic cracking facilities, Liquid process wastes, Oil pollution, Benzene, West Germany, Gravimetric method, Napthalene, Infrared spectroscopy.

Effluents from three West German oil refineries with catalytic cracking facilities were analyzed. In all three cases, samples were obtained downstream from the oil separator; they all consisted mainly of liquid process wastes and oil-polluted rainwater. Proportional contents of hydrocarbon groups were evaluated. The individual n-alkanes differed by a maximum factor of three, but there were widely differing concentration ratios among the aromatic hydrocarbon groups. The concentrations of benzene and benzene derivatives were more or less the same, with the absolute values differing by at most a factor of two, whereas in the case of naphthalene and its alkylated derivatives the differences ranged to multiples of 10-20 times. This concentration pattern continued or became even more marked in the case of the more highly condensed aromatics. These comparisons demonstrate how problematic it is to compare total hydrocarbon contents among refineries by the infrared or gravimetric methods. (Rochester-PTT)
W86-04388

METHODS FOR VALIDATION OF PRECIPITATION PH: APPLICATIONS TO TEXAS DATA,
Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
H. M. Liljestrand, J. D. Mohr, and M. A. Stafford.
Journal of Environmental Science and Health JESEDU, Vol. A21, No. 2, p 151-168, 1986. 2 fig, 3 tab, 38 ref. Texas Air Control Board IAC (84-85) - 1566.

Descriptors: *Statistical methods, *Acid rain, *Anions, *Cations, *Hydrogen ion concentration, *Texas, Charge balance, Acidity, Validation procedure, Data interpretation.

Methods for the validation of reported pH values were developed for incomplete precipitation chemistry data sets. The most stringent tests are based on a comparison between the net strong acidity calculated from the conservative inorganic cations and anions and that determined from the measured pH. The strong acidity of a sample in equilibrium with atmospheric carbon dioxide can be determined from an accurate pH measurement. Less severe tests are based on charge and conductivity balances. The proposed methods were applied to Texas precipitation chemistry data to identify unreliable measurements and to determine the spatial distribution of the mean pH for validated data. Reported mean pH values, especially those greater than pH5, are lower than can be validated. For data sets with a complete analysis of the major ionic species, the comparison of net acidities is generally a stronger quality assurance test for the validation of pH measurements than the charge balance. (Author's Abstract)
W86-04389

SPECIFIC CONDUCTANCE AS AN INDICATOR OF TOTAL DISSOLVED SOLIDS IN COLD, DILUTE WATERS,
Institute of Hydrology, Wallingford (England).
For primary bibliographic entry see Field 2K.
W86-04394

NITRIFICATION, NITRATE REDUCTION, AND NITROGEN IMMOBILIZATION IN A TIDAL FRESHWATER MARSH SEDIMENT,
Marine Biological Lab., Woods Hole, MA. Ecosystems Center.
For primary bibliographic entry see Field 2K.
W86-04399

DETERMINATION OF ALKYLETHOXYLATED SULFATES IN WASTEWATERS AND SURFACE WATERS,
Procter and Gamble Co., Cincinnati, OH.
T. A. Neubecker.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1232-1236, December 1985. 3 fig, 4 tab, 6 ref.

Descriptors: *Pollutant identification, *Surfactants, *Gas chromatography, *Wastewater analysis, *Surface water, Anion exchange, Organic compounds, Water analysis, Separation techniques, Domestic wastes, Sulfates, Alkylethoxylated sulfates, Alkylethoxylate.

A novel method was developed for the determination of parts per billion levels of alkylethoxylated sulfates (AES) in wastewaters and surface waters. The analysis scheme involves concentration of the AES on an anion-exchange resin, elution of the resin with methanolic HCl, hydrolysis of the AES to alkylethoxylate (AE), extraction of the AE from the remaining ionic species, derivatization to the corresponding alkyl bromides, and analysis of the alkyl bromides by gas chromatography. Recovery of several AES homologues through this scheme ranges from 68 to 78% with an estimated sensitivity of approximately 1 ppb for each alkyl-chain homologue of AES. AES levels were measured in several wastewater and surface water samples by using this method and the nonspecific methylene blue active substance (MBAS) method. Results indicate that only about 10% of the total MBAS response arises from AES. (Author's abstract)
W86-04430

AROMATIC HYDROCARBONS IN NEW YORK BIGHT POLYCHAETES: ULTRAVIOLET FLUORESCENCE ANALYSES AND GAS CHROMATOGRAPHY/GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSES,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04432

QUANTITATIVE DETERMINATION OF PARTIALLY HYDROLYZED POLYACRYLAMIDE POLYMERS IN OIL FIELD PRODUCTION WATER,
Marathon Oil Co., Littleton, CO. Denver Research Center.
P. M. Beazley.
Analytical Chemistry, Vol. 57, No. 11, p 2098-2101, September 1985. 8 fig, 1 tab, 13 ref.

Descriptors: *Chemical analysis, *Hydrolyzation, *Polyacrylamide polymers, Oil recovery, Industrial wastewater, Chromatography, Elution, Wastewater analysis, Polymers.

Partially hydrolyzed polyacrylamide (PHPA) is commonly used for mobility control in surfactant-based enhanced oil recovery processes and for polymer augmented water floods. PHPA can be determined in a concentration range of 1 ppm to 100 ppm in dirty oil field water with a precision of + 1% and a lower limit of detection of 10 ppb. Solutions of high molecular weight PHPA are analyzed by high-performance size exclusion chromatography with 100 angstrom pore size, diol bonded phase silica columns eluted with a 0.1 M sodium perchlorate and 0.005 M pentanesulfonic acid paired ion reagent solution. Ultraviolet detection at a 190 nanometer wavelength is used for quantitation. Polymer solutions must be shear degraded to prevent column plugging. Analyses of water produced by both polymer and polymer plus sulfonate surfactant floods are illustrated. (Lantz-PTT)
W86-04435

DETERMINATION OF SUB-NANOGRAM-PER-LITER LEVELS OF MERCURY IN LAKE WATER WITH ATMOSPHERIC PRESSURE HELIUM MICROWAVE INDUCED PLASMA EMISSION SPECTROMETRY,
National Inst. for Environmental Studies, Tsukuba (Japan).
Y. Nojiri, A. Otsuki, and K. Fuwa.
Analytical Chemistry, Vol. 58, No. 3, p 544-547, March 1986. 3 fig, 1 tab, 29 ref.

Descriptors: *Mercury, *Chemical analysis, *Water analysis, *Lakes, Helium, Microwaves, Emission spectroscopy, Atmospheric pressure, Lake Mashu, Water pollution, Japan.

A highly sensitive method for the analysis of mercury (Hg) was developed utilizing atmospheric pressure helium (He) microwave induced plasma (He-MIP) emission spectrometry. Mercury vapor was generated from water samples by reduction and purging and was collected with a gold amalgamation trap. The Hg vapor, removed by heating the trap, was introduced into the He-MIP. The atomic emission line of 253.7 nanometers (nm) was used for the determination of Hg. The detection limit, defined as 3 times the standard deviation of the blank operations, was 0.5 pg in 50 mL of water sample, corresponding to 0.01 ng/L. The method was applied to the determination of ultratrace levels of Hg in lake water samples. An improvement of absolute detection limit of 1 order of magnitude, compared with previously reported work, was achieved by use of the amalgamation apparatus. The reasons for this improvement are: (1) Separation of the large amount of water mist from the Hg vapor by the amalagamator might enhance the Hg emission in the plasma; (2) Separation of dissolved concomitants and gases might reduce the spectral interference at the Hg emission line, where nitrogen-containing compounds, especially, give a NO band emission; (3) Sharpening of the peak might give a higher concentration of Hg in the plasma excitation source; and, (4) The removal of contaminating Hg in the reducing reagent might reduce the blank. Contamination from marketing reagents corresponded to about 100 pg without purification. The detection limit obtained in this study (0.5 pg) was of the same order as that of methylmercury(II)chloride by the gas chromatography-MIP system. MIP emission spectrometry may have the detection capability of this order with gas-phase Hg introduction. The inorganic Hg concentration in subsurface water from unpolluted Lake Mashu was found to be 0.3 ng/L. (Lantz-PTT)
W86-04436

AMMONIA AND UREA DETERMINATION IN WATER SAMPLES USING AMBERLITE XAD-7 TO CONCENTRATE INDOPHENOL,
Palma de Mallorca Univ. (Spain). Dept. of Biochemistry.
P. Moreno, E. Sanchez, A. Pons, and A. Palou.
Analytical Chemistry, Vol. 58, No. 3, p 585-587, March 1986. 5 fig, 1 tab, 16 ref.

Descriptors: *Ammonia, *Urea, *Indophenol, Resins, Amberlite, Saline water, Water pollution, Water analysis, Chemical analysis.

The indophenol method for ammonia estimation has been modified and adapted by several researchers, with the basic method being the treatment of water samples, in an alkaline medium, with sodium hypochlorite and phenol, in the presence of nitroprusside. The blue indophenol formed with ammonia is then measured colorimetrically. Since indophenol is not the only product of the reaction, the treatment of different types of samples can provide different suites of chromophores, creating interference in the measurement of ammonia. A modification of the indophenol method for the determination of ammonia and urea in the same sample, is described. Indophenol, formed proportionally to the amount of ammonia available, is selectively concentrated in a single purification-concentration step, using simple and recyclable columns of Amberlite XAD-7 resin, increasing the sensitivity of the method. Its application to seawater samples is described. The procedure is applicable to the anal-

ysis of large numbers of samples running simultaneously in routine studies, and eliminates possible artifacts that may alter the precision and sensitivity of the method. (Lantz-PTT)
W86-04437

SOLUTION OF HYDROCARBONS IN A HYDROCARBON-WATER SYSTEM WITH CHANGING PHASE COMPOSITION DUE TO EVAPORATION,
Virginia Inst. of Marine Science, Gloucester Point.
For primary bibliographic entry see Field 5B.
W86-04443

CHEMILUMINESCENCE VS. KJELDAHL DETERMINATION OF NITROGEN IN OIL SHALE RETORT WATERS AND ORGANONITROGEN COMPOUNDS,
California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, and C. G. Daughton.
Analytical Chemistry, Vol. 57, No. 12, p 2320-2325, October 1985. 1 fig, 3 tab, 28 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Chemiluminescence, *Kjeldahl procedure, *Nitrogen, *Oil wastes, *Organic compounds, Oil shale, Industrial wastewater, Chemical analysis, Water pollution control, Statistical analysis.

Pyrolysis of oil shale kerogen yields a petroleum-like crude oil and byproducts, including retorted (spent) shale, gases, and wastewaters. Most of the wastewater (retort water) is condensed with the product oil from which it is separated; the remaining water (gas condensate) is condensed from a gaseous stream. Although it is possible that this contamination could be minimized by limiting the oil/water contact time, the retort waters that have been available from pilot-scale facilities are highly contaminated with a complex spectrum of inorganic and organic solutes and suspended matter. The applicability of combustion/chemiluminescence nitrogen analysis to quantifying nitrogen in oil shale wastewaters and various representative chemical classes was demonstrated. Only azoxy compounds and those containing the pyrazole nucleus were not amenable to analysis. The majority of 56 compounds tested yielded from 90% to 110% of their theoretical nitrogen contents; enhanced recovery was found for nitrogen salts. For 12 oil shale wastewaters, combustion/chemiluminescence gave total nitrogen values (1100-28800 mg/L) that did not differ statistically (P>0.10) from those obtained by the time-consuming wet-chemical Kjeldahl method. The relative standard deviations for ten replicates of each wastewater were less than 3.5%. No matrix or solvent effects were found. (Lantz-PTT)
W86-04445

COMPARISON OF ULTRAVIOLET AND REDUCTIVE AMPEROMETRIC DETECTION FOR DETERMINATION OF ETHYL AND METHYL PARATHION IN GREEN VEGETABLES AND SURFACE WATER USING HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Middle Tennessee State Univ., Murfreesboro. Dept. of Chemistry and Physics.
g. J. Clark, R. R. Goodin, and J. W. Smiley.
Analytical Chemistry, Vol. 57, No. 12, p2223-2228, October 1985. 6 fig, 4 tab, 10 ref.

Descriptors: *Water analysis, *Ultraviolet radiation, *Electrochemistry, *Ethyl parathion, *Methyl parathion, *Vegetables, *Surface waters, High performance liquid chromatography, Pesticides, Sample preparation, Measuring instruments.

Ethyl and methyl parathion have been two popular organophosphorus pesticides applied to a variety of crops including green vegetables. A method was developed for the determination of ethyl and methyl parathion residues on vegetable materials and surface water samples using reverse-phase high-performance liquid chromatography with series UV-electrochemical detection. Techniques were developed for sample preparation, which avoided the usual preliminary column fractionations and which allowed the parathions to be recovered with an average of 95% recovery at concentrations less than 50 nanograms/g for the plant material. Relative standard deviations of about 5% were obtained using five different plant samples. Concentrations less than 10 ng/mL were readily measured in water samples using a column concentration procedure. The selectivity of electrochemical detection made it unnecessary to chromatographically resolve the plant components from the pesticides which were electrochemically active and allowed rapid analysis. Series detection proved useful in distinguishing various components in the samples from pesticides, in distinguishing various pesticides, and in comparing the operating characteristics of the two detectors. (Lantz-PTT)
W86-04446

ORGANIC NITROGEN DETERMINATION IN OIL SHALE RETORT WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
C. G. Daughton, B. M. Jones, and R. H. Sakaji.
Analytical Chemistry, Vol. 57, No. 12, p 2326-2333, October 1985. 2 fig, 3 tab, 32 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Organic compounds, *Nitrogen, *Oil shale, *Oil wastes, Organonitrogen compounds, Ammonia, Chemiluminescence, Chemical analysis, Chromatography, Dialysis, Kjeldahl procedure, Statistical analysis.

Organonitrogen compounds (ONCs) are a predominant class of organic solutes in oil shale process wastewaters. These waters also usually contain high concentrations of ammonia, often an order of magnitude greater than the organic N concentration. Two new approaches were used to separate ammonia from various fractions of organonitrogen compounds in oil shale wastewaters, thereby permitting the application of a rapid, but unselective method for total N determination (combustion/chemiluminescence) to the direct estimation of organic N. The first method uses reverse-phase chromatography to separate polar from nonpolar nitrogenous compounds, while the second uses non-osmotic dissolved-gas dialysis to separate volatile from nonvolatile nitrogenous solutes. For 12 oil shale retort waters, correlation of the resulting measures of organic N against organic Kjeldahl nitrogen values gave correlation coefficients for the nonpolar and nonvolatile nitrogen values of 0.920 and 0.996, respectively. Relative standard deviations averaged 3.9%. Combining the two methods yielded higher estimates of organic N; correlation coefficient of 0.989. Organic N concentrations for the waters measured by all four methods ranged from 15 to 5000 mg/L. These data showed, that on the average, at least one-half to three-fourths of the organic carbon was associated with nitrogen. (Lantz-PTT)
W86-04447

COMPARISON OF MICROCOLORIMETRIC AND MACROTITRIMETRIC METHODS FOR CHEMICAL OXYGEN DEMAND OF OIL SHALE WASTEWATERS,
California Univ., Berkeley. Lawrence Berkeley Lab.
B. M. Jones, R. H. Sakaji, and C. G. Daughton.
Analytical Chemistry, Vol. 57, No. 12, p 2334-2337, October 1985. 2 fig, 1 tab, 17 ref. DOE Contract No. DE-AC03-76SF00098.

Descriptors: *Microcolorimetry, *Macrotitrimetry, *Chemical oxygen demand, *Oil shale, Oil wastes, Industrial wastewater, Biological oxygen demand, Chemical analysis.

The chemical oxygen demand (COD) test was originally used as a rapid estimator of the biochemical oxygen demand (BOD) of wastewater organic material. The numerical value obtained from a COD test reflects both the organic carbon concentration and the overall oxidative state of the organic material. The COD of a sample is defined by the absolute amount of hexavalent chromium that is reduced during 2 h of digestion by potassium dichromate in a solution of 50% sulfuric acid. Modifications are described for both the microcolorimetric and macrotitrimetric COD procedures. For the former, a prolonged cooling period, followed by extensive mixing, minimizes the spectrophotometric interference from refractive index changes and catalyst-induced precipitate. For the latter, automated titration and absorbance monitoring near the chromate-chromic isosbestic point improves accuracy and reproducibility. The applicability of these modified methods for quantifying the COD of oil shale wastewaters was demonstrated. For 12 oil shale wastewaters, the microcolorimetric method gave COD values (900-150000 mg/L) that did not differ statistically (P>0.10) from those obtained by the macrotitrimetric COD method. The relative standard deviations for five replicates of each wastewater were less than 1.3% for the macrotitrimetric method and generally less than 5% for the microcolorimetric method; no matrix effects were evident. (Lantz-PTT)
W86-04448

INTERLABORATORY STUDY ON DETERMINATION OF POLYCHLORINATED BIPHENYLS IN ENVIRONMENTALLY CONTAMINATED SEDIMENTS,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
A. L. Alford-Stevens, W. L. Budde, and T. A. Bellar.
Analytical Chemistry, Vol. 57, No. 13, p 2452-2457, November 1985. 5 tab, 6 ref.

Descriptors: *Polychlorinated biphenyls, *Water pollution, *Sediments, *Chemical analysis, Electron capture detectors, Mass spectrometry, Aroclor, Data analysis, Mathematical analysis, Measuring instruments.

Three samples of sediments environmentally contaminated with polychlorinated biphenyls (PCBs) were analyzed by ten different laboratories using uniform calibration standards and standardized procedures for sample extraction, extract preparation, and chromatography. Six laboratories identified and measured PCBs as commercial Aroclor mixtures with electron capture (EC) detectors, and four used mass spectrometer (MS) detectors. All three sediments contained a mixture of Aroclors 1242 and 1254 but at different concentrations, approximately 0.2, 3 and 50 mg/kg, respectively. Procedural variations were introduced in some laboratories, and large differences in results were reported by participating laboratories, despite written standardized procedures. For EC data, the overall relative standard deviation of measurements of total Aroclor concentrations was 30%; for MS data deviation was 38%. The relatively complex calculations required to obtain Aroclor concentrations were an important source of data variability as well as being tedious and labor-intensive. (Lantz-PTT)
W86-04449

MASS SPECTROMETRIC DETERMINATION OF POLYCHLORINATED BIPHENYLS AS ISOMER GROUPS,
Battelle Columbus Div., OH.
J. E. Gebhart, T. L. Hayes, A. L. Alford-Stevens, and W. L. Budde.
Analytical Chemistry, Vol. 57, No. 13, p 2458-2463, November 1985. 1 fig, 8 tab, 4 ref.

Descriptors: *Mass spectrophotometry, *Polychlorinated biphenyls, *Isomers, Measuring instruments, Chemical analysis, Data interpretation, Chlorination, Aroclor, Gas chromatography, Computers.

A procedure to measure concentrations of polychlorinated biphenyls (PCBs) by using nine selected PCB congeners as concentration calibration standards was developed and applied to well-characterized samples. With this procedure, PCBs were not identified and measured as Aroclors. Instead, a gas chromatograph equipped with a capillary column and interfaced to a computerized mass spectrometer (MS) was used to detect and identify PCBs by level of chlorination. Concentrations were measured for each isomer group and for total

PCBs present. For concentration calibration, one PCB isomer represented all isomers at each level of chlorination, except that decachlorobiphenyl represented isomers containing nine and ten chlorines. One internal standard, chrysene-d sub 12, was used to calibrate MS response. Data interpretation is a practical limitation to implementation of the approach to PCB determinations described in this paper. The approach depends on the use of capillary columns to separate as many of the PCB congeners as possible. Therefore, numerous mass spectra must be inspected to assign each detected PCB to a level of chlorination. Extensive computations are required to obtain quantitative measurements. To improve the cost effectiveness of this approach, automated interpretation and computation are needed. The nature of mass spectral data and the dedicated minicomputer interfaced with contemporary GC/MS systems make automation entirely feasible, but specialized software is needed. (Lantz-PTT)
W86-04450

PERFORMANCE TESTS FOR THE MEASUREMENT OF PH WITH GLASS ELECTRODES IN LOW IONIC STRENGTH SOLUTIONS INCLUDING NATURAL WATERS,
Freshwater Biological Association, Ambleside (England).
For primary bibliographic entry see Field 7B.
W86-04451

CHARACTERIZATION OF DYES IN ENVIRONMENTAL SAMPLES BY THERMOSPRAY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY,
Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
R. D. Voyksner.
Analytical Chemistry, Vol. 57, No. 13, p 2600-2605, November 1985. 7 fig, 5 tab, 25 ref. EPA Contract 68-03-3122.

Descriptors: *Dyes, *Environmental tracers, *Mass spectrometry, *Chromatography, Water quality control, Thermospray, Anthraquinone, Groundwater pollution, Wastewater, Gasoline, Dye tracers, Diazo dyes, Azo dyes, Anthraquinone dyes.

Dyes play a significant role in products consumed in the United States. They are used in products such as textiles, paper, leather, and foodstuffs. Also, dyes are required by law to be in leaded gasoline to indicate the presence of lead. In addition, unleaded gasoline can contain dyes to identify gasoline manufacturers and to trace a seepage into soil or groundwater. The use of thermospray HPLC/MS to characterize azo, diazo, and anthraquinone dyes in wastewater and gasoline is demonstrated. Thermospray analysis of these dyes primarily produced (M + H)(+) ions with few fragments. 'Filament on' operation of the interface aided in the production of fragment ions for the azo dyes analyzed. The commercial diazo and anthraquinone dyes analyzed by HPLC/MS proved to be very complex mixtures of nearly 40 alkyl-substituted dye components, making monitoring and identification of a particular dyestuff very difficult. Thermospray HPLC/MS methods are demonstrated to detect dyes down to 10 ppt (parts per trillion) in wastewater, 100 ppb in soil, and 1 ppm in gasoline. The 'filament on' operation of the thermospray interface provided additional fragment ions, aiding the structural elucidation of these dyes. (Lantz-PTT)
W86-04452

DETERMINATION OF ATRAZINE, LINDANE, PENTACHLOROPHENOL, AND DIAZINON IN WATER AND SOIL BY ISOTOPE DILUTION GAS CHROMATOGRAPHY/MASS SPECTROMETRY,
Acurex Corp., Mountain View, CA. Energy and Environmental Div.
V. Lopez-Avila, P. Hirata, S. Kraska, M. Flanagan, and J. H. Taylor, Jr.
Analytical Chemistry ANCHAM, Vol 57, No. 14, p 2797-2801, December 1985. 2 fig, 4 tab, 8 ref. EPA Contract No. 68-03-3100 and 68-03-3226.

Descriptors: *Atrazine, *Lindane, *Pentachlorophenol, *Diazinon, *Chemical analysis, Gas chromatography, Mass spectrometry, Water pollution, Pesticides, Soil chemistry, Soil analysis, Water analysis.

Described is an isotope dilution GC/MS technique for the analysis of low-parts-per-billion concentrations of atrazine, lindane, pentachlorophenol, and diazinon in water and soil. Known amounts of stable-labeled isotopes such as atrazine-d sub 5, lindane-d sub 6, and diazinon-d sub 10 are spiked into each sample prior to extraction. Water samples are extracted with methylene chloride, while soil samples are extracted with acetone/hexane. Analysis is performed by high-resolution GC/MS with the mass spectrometer operated in the selected ion monitoring mode. Accuracy greater than 86% and precision better than 8% were demonstrated by the use of spike samples. This technique has been used successfully in the analysis of over 300 water and 300 soil samples. Detection limits of 0.1-1.0 ppb were achieved for the test compounds by selected ion monitoring GC/MS. (Lantz-PTT)
W86-04455

CONCENTRATION OF TRACE ELEMENTS IN WATER SAMPLES BY REDUCTIVE PRECIPITATION,
Colorado State Univ., Fort Collins. Dept. of Chemistry.
R. K. Skogerboe, W. A. Hanagan, and H. E. Taylor.
Analytical Chemistry ANCHAM, Vol. 57, No. 14, p 2815-2815, December 1985. 1 fig, 4 tab, 25 ref.

Descriptors: *Trace elements, *Water sampling, *Reductive precipitation, Chemical analysis, Preconcentration, Borohydride, Precipitation, Cobalt, Nickel, Copper, Iron, Manganese.

The use of borohydride reduction as a means of preconcentrating elements by precipitation as the element or as a boride has been explored. Elements that can be precipitated by this mechanism include Co, Cu, Fe, Mn, and Ni. Only four of these exhibited recoveries less than 90%. Preconcentration by reductive precipitation offers several potential advantages including (1) broad applicability to 23 elements, including 12 of the 13 on the U.S. Environmental Protection Agency priority pollutant list; (2) exclusion of the major and minor elements, such as Ca, Mg, Na, and K, and the analytical interferences associated with them; (3) the possibility of doing direct analyses on the precipitate, followed by dissolution for solution analyses; (4) the high reduction potential of borohydride (E(o) = 1.24V) means that competitive metal complexation should not be significant and interfere with preconcentration; (5) the preparation of the borohydride reagent solution should result in the removal of contaminants by reductive precipitation, so the reagent is self-cleaning; and (6) high preconcentration factors should be easily attainable. (Lantz-PTT)
W86-04456

DETERMINATION OF TRACE ELEMENTS IN RAINWATER BY TOTAL-REFLECTION X-RAY FLUORESCENCE,
GKSS - Forschungszentrum Geesthacht G.m.b.H., Geesthacht-Tesperhude (Germany, F.R.). Inst. fuer Physik.
R. -P. Stossel, and A. Prange.
Analytical Chemistry ANCHAM, Vol. 57, No. 14, p 2880-2885, December 1985. 4 fig, 3 tab, 17 ref.

Descriptors: *Rain, *Atmospheric deposition, *Water pollution sources, *Trace elements, *Chemical analysis, *Total-reflection X-ray fluorescence, Chemistry of precipitation, Freeze drying, Chromatography, Island of Pellworm, West Germany.

Three quasi-independent analytical procedures for the determination of trace elements in rainwater are presented, which are based on total-reflection X-ray fluorescence (TXRF), a special variant of energy-dispersive X-ray fluorescence. The sample preparation techniques compared are (1) direct analysis, (2) preenrichment of the trace elements in rainwater by freeze-drying and redissolution in dilute nitric acid, and (3) a matrix removal and preconcentration procedure by metal chelation, chromatographic adsorption of the metal complexes, and subsequent elution of the metal chelates prior to TXRF measurement. The elements determined are S, K, Ca, Ti, V, Cr, Mn, Fe, Co, Ni, Cu, Zn, As, Pb, Se, Rb, Sr, Mo, Cd, and Ba. For a measuring time of 1000 sec, detection limits down to 5-20 nanograms/L were achieved for the heavy-metal traces. The limits are slightly higher for iron, nickel, copper, zinc, and lead because of fluctuations in the blank values. The procedures were tested on rainwater samples from the Island of Pellworm (German bight) containing comparatively low trace-metal contents. Systematic investigations for the characterization of the analytical procedures with regard to blanks, detection limits, precision, and accuracy are described and discussed. The accuracy was checked by independent analyses of duplicate samples using differential pulse anodic stripping voltammetry. (Lantz-PTT)
W86-04457

DETERMINATION OF SELENIUM SPECIATION IN BIOGENIC PARTICLES AND SEDIMENTS,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
G. A. Cutter.
Analytical Chemistry ANCHAM, Vol. 57, No. 14, p 2951-2955, December 1985. 1 fig, 3 tab, 22 ref. EPRI Grant RP 2020-1.

Descriptors: *Selenium, *Path of pollutants, *Speciation, *Sediments, *Biogenic particles, Natural waters, Plankton, Quantitative analysis, Chemical analysis, Nitric acid, Perchloric acid, Sodium hydroxide.

Selenium can exist in a variety of chemical forms in the suspended particles and bottom sediments of natural waters. Described here is a method that can quantitatively reveal the chemical speciation of selenium in particulate materials such as plankton, planktonic detritus, and sediments. This procedure uses a multistep nitric/perchloric acids digestion to solubilize total selenium and a weak sodium hydroxide treatment to release selenite and selenate. The solubilized selenium species are determined by a selective hydride generation/atomic absorption technique. Accuracy was verified by using a combination of standard reference materials, radiotracers, and existing sediment leach methods. For field and reference samples the average precision (relative standard deviation) for total selenium determinations is 8.8% (n = 8 samples) and 19.3% for selenite + selenate determinations (n = 6 samples). The detection limit for total particulate selenium is 10 nanograms/g using a sample size of 0.2 g. The method has been used on a variety of plankton, planktonic detritus, and sediment samples. (Lantz-PTT)
W86-04458

SPECIATION OF LEAD AND METHYLLEAD IONS IN WATER BY CHROMATOGRAPHY/ATOMIC ABSORPTION SPECTROMETRY AFTER ETHYLATION WITH SODIUM TETRAETHYLBORATE,
New Hampshire Univ., Durham. Dept. of Chemistry.
S. Rapsomanikis, O. F. X. Donard, and J. H. Weber.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 35-38, January 1986. 3 fig, 1 tab, 24 ref. NSF Grant CEE 81-16960.

Descriptors: *Lead, *Water analysis, *Speciation, *Chromatography, *Atomic absorption spectroscopy, Methyllead, Chemical analysis, Sodium tetraethylborate, Algorithms, Mathematical analysis.

A novel method for speciation and determination of Me3Pb(+) and Me2Pb(2+) in water, is described. The procedure includes in situ ethylation by sodium tetraethylborate (NaBEt4) in water, purging and trapping of alkyllead molecules, and thermal desorption in an electrically heated quartz atomic absorption (AAS) furnace. The absolute

detection limits of Pb for 50 cu cm are approximately 8.7 pg for Me3Pb(+) (0.18 pg/cu cm) and approximately 10.5 pg for Me2Pb(2+) (0.21 pg/cu cm). Major advantages for the technique are avoidance of solvent extraction and sample transfers because ethylation to Me3EtPb and Me2Et2Pb takes place in a closed system. Reaction conditions and apparatus operating parameters were optimized by a Simplex algorithm. (Lantz-PTT)
W86-04459

DETERMINATION OF THE CARBAMATE HERBICIDE PROPHAM BY SYNCHRONOUS DERIVATIVE SPECTROFLUOROMETRY FOLLOWING FLUORESCAMINE FLUOROGENIC LABELING,
Malaga Univ. (Spain). Dept. of Analytical Chemistry.
F. G. Sanchez, and C. C. Blanco.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 73-76, January 1986. 1 fig, 3 tab, 14 ref.

Descriptors: *Herbicides, *Propham, *Isopropyl phenylcarbonate, *Fluorescence, *Spectrofluorometry, Fluorogenic labeling, Chemical analysis, Water analysis, Well water, Mathematical analysis, Pesticides.

Three methods for the determination of propham by fluorogenic labeling with fluorescamine and synchronous derivative spectrofluorometry are described and discussed. The herbicide is hydrolyzed in 1 M NaOH at 100 C for 40 min, and the liberated aniline reacts instantaneously with fluorescamine in an aqueous buffer solution (pH 4.0). Reaction rates, fluorescence phenomena, and synchronous derivative parameters are investigated. To enhance sensitivity, the analysis of the fluorescamine derivative is used following extraction in ethyl acetate. Linear analytical curves are obtained between 24 and 2000 nanograms/mL. The minimum detectable quantity is estimated to be 7.2 nanograms/mL. Well water samples containing low concentrations of carbamate are also analyzed. The method is simple, rapid, and reproducible. Combination of the fluorogenic labeling with the sensitivity of the synchronous derivative technique, enhanced by the organic solvent extraction, gives analytical results comparable to those obtained by thin-layer chromatography. It is a convenient and simple means of analysis of pesticide residues when sophisticated and expensive instrumentation is not available. (Lantz-PTT)
W86-04460

EXTRACTION OF ARSENIC (IID AND ARSENIC (V) FROM NATURAL WATERS FOR NEUTRON ACTIVATION ANALYSIS,
Idaho Univ., Moscow. Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-04461

REVERSED-PHASE HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITROORGANICS IN MUNITIONS WASTEWATER,
Cold Regions Research and Engineering Lab., Hanover, NH.
T. F. Jenkins, D. C. Leggett, C. L. Grant, and C. F. Bauer.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 170-175, January 1986. 4 fig, 4 tab, 32 ref.

Descriptors: *Munitions wastewater, *Chromatography, *Nitroorganic compounds, TNT, RDX, HMX, 2,4-DNT, Industrial wastewater, Methanol, Acetonitrile, High performance liquid chromatography, Chemical analysis, Statistical analysis.

Concentrations of HMX, RDX, TNT, and 2,4-DNT are determined in munitions wastewater. Aqueous samples are diluted with an equal volume of 76/24 (v/v) methanol-acetonitrile, filtered through a 0.4 micrometer polycarbonate membrane, and analyzed by reversed-phase HPLC using an LC-8 column with 50/38/12 (v/v/v) water-methanol-acetonitrile. The method provided linear calibration curves to at least several hundred micrograms/l. Detection limits were conservatively estimated to be 26, 22, 14, and 10 microgram/l for HMX, RDX, TNT, and 2,4-DNT, respectively, with corresponding standard deviations of + 3.4, 3.3, 4.4, and 4.6 micrograms/l up to concentrations of 250 micrograms/l. At higher concentrations, the percent relative standard deviation values were approximately + 2% for HMX and RDX and + 4% for TNT and DNT. A ruggedness test involving the major manipulative steps in the procedure, was tested with munition wastewater from several Army ammunition plants and found to perform adequately for load and pack wastewaters, wastewater from HMX/RDX manufacture, and contaminated groundwater. (Lantz-PTT)
W86-04462

INTERLABORATORY EVALUATION OF HIGH-PERFORMANCE LIQUID CHROMATOGRAPHIC DETERMINATION OF NITROORGANICS IN MUNITION PLANT WASTEWATER,
New Hampshire Univ., Durham. Dept. of Chemistry.
C. F. Bauer, C. L. Grant, and T. F. Jenkins.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 176-182, January 1986. 6 fig, 6 tab, 11 ref.

Descriptors: *Nitroorganic compounds, *Munitions wastewater, *Chromatography, DNT, TNT, RDX, HMX, Industrial wastewater, High performance liquid chromatography, Chemical analysis, Statistical analysis.

A reversed-phase HPLC method for the determination of nitroorganic compounds (DNT, TNT, RDX, HMX) in munitions wastewaters was evaluated in a collaborative study. Nine laboratories analyzed four aqueous matrices, including groundwater and treated wastewater, which were spiked with the analytes at levels from 30 to 600 micrograms/l. Recoveries of analytes were similar regardless of matrix: DNT and RDX being recovered quantitatively, and TNT and HMX showing losses of about 5%. Intralaboratory precisions, based on the average of duplicate determinations, were less than 15 micrograms/l, which corresponds to 9% relative standard deviation at the average concentration examined. Interlaboratory precisions were at most 50% larger than intralaboratory values. Valid statistical analysis required rejection of about 10% of the data set as outliers. (Lantz-PTT)
W86-04463

EFFECTS OF FLOW RATE AND PRETREATMENT ON THE EXTRACTION OF TRACE METALS FROM ESTUARINE AND COASTAL SEAWATER BY CHELEX-100,
National Oceanic and Atmospheric Administration, Seattle, WA. Pacific Marine Environmental Lab.
A. J. Paulson.
Analytical Chemistry ANCHAM, Vol. 58, No. 1, p 183-187, January 1986. 1 fig, 2 tab, 21 ref.

Descriptors: *Trace metals, *Flow rates, *Coastal estuaries, *Estuaries, *Chelex-100, Saline water, Temperature effects, Ultraviolet oxidation, Iron.

During the extraction of previously acidified estuarine samples, altered organic material still retains some capacity to inhibit the extraction of trace metals by Chelex-100. Previous studies have indicated that heating or UV oxidation of samples reduces the capacity of this organic matter to inhibit the extraction of trace metals by Chelex-100. The results of this study using recently collected samples indicate that decreasing the flow rate to 0.2 microliters/min is another effective means of increasing the retention of trace metals by Chelex-100. Additional benefits of the slow-flow column extraction method include improvements in precision and the elimination of pretreatment procedures that could cause contamination or reduce the extractability of Fe. Aged acidified samples require heating of the sample prior to extraction. Controlled contamination can be minimized for most metals by preextraction of the buffer solution. (Lantz-PTT)
W86-04464

ATMOSPHERIC ENVIRONMENT SERVICE LONG RANGE TRANSPORT OF AIR POLLUTANT ACTIVITIES IN THE TERRITORIES,
Atmospheric Environment Service, Edmonton (Alberta).
R. B. Thomson.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 109-115, 1986. 2 fig, 5 tab, 15 ref.

Descriptors: *Distribution patterns, *Acid rain, *Air pollution, *Networks, Sulfur, Spatial distribution, Temporal distribution, Sample preparation, Sampling, Canadian, Network for Sampling Precipitation, Northwest Territories Precipitation Chemistry Network, Data collections.

Measurements of chemical constituents in precipitation in the Northwest Territories and Yukon have been made on a regular basis since 1974 as part of Environment Canada's Background Air Pollution Monitoring Network which expanded in 1976 to become the Canadian Network for Sampling Precipitation (CANSAP). In 1984, the Northwest Territories Precipitation Chemistry Network (NWTPCN) was established jointly by the Pollution Control Division, Department of Renewable Resources, Government of the Northwest Territories (GNWT) and Atmospheric Environment Service (A.E.S.), Environment Canada. This report discusses the precipitation chemistry data collected from CANSAP sites in the Territories as well as the results of two modelling studies. Details of the new Canadian Air and Precipitation Monitoring Network (CAPMoN) and NWTPCN are presented. The values of sulfur deposition obtained from the CANSAP network and those calculated from model output indicate levels are near background. However, good quality precipitation chemistry samples were difficult to collect, and at this time modeling results are limited. Sampling of precipitation chemistry must continue in concert with other methods to provide a comprehensive data bank for further studies. Field programs and sampling networks must be established to enhance both the temporal and spatial information related to long range transport of air pollution. Once such a database is available, atmospheric models can be tested, validated and then used to describe future scenarios to insure adequate environmental guidelines are in place to protect sensitive areas while development proceeds. (Lantz-PTT)
W86-04483

AIRBORNE MERCURY IN PRECIPITATION IN THE LAKE SUPERIOR REGION,
Environmental Research Lab.-Duluth, MN.
For primary bibliographic entry see Field 5B.
W86-04525

RELATIONSHIPS BETWEEN CHLORINATED HYDROCARBON CONCENTRATIONS AND REARING MORTALITY OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EGGS FROM LAKE MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
For primary bibliographic entry see Field 5C.
W86-04528

OPTIMIZATION OF THE ICP WORKING CONDITIONS FOR THE ANALYSIS OF WASTE WATERS AND INDUSTRIAL SOLUTIONS,
Institute 'Niproruda', Sofia (Bulgaria).
A. Delijska, and Z. Zadgorska.
Fresenius Zeitschrift fur Analytische Chemie ZACFAU, Vol. 322, p 413-418, 1985. 8 fig, 4 tab, 21 ref.

Descriptors: *Inductively coupled plasma atomic emission spectroscopy, *Spectroscopy, *Metals, *Sulfuric acid, *Salt, Aluminum, Calcium, Cadmium, Copper, Iron, Magnesium, Manganese, Nickel, Lead, Zinc, Chemical analysis.

In order to optimize the working parameters of inductively coupled plasma (ICP) analysis of waste waters and industrial solutions the spectral influences, optimization of aerosol gas flow, and nebuli-

zation and transport effects were examined. Special attention was paid to the influence of high contents of salt and H2SO4 in some samples. The use of a peristaltic pump, dilution or internal standardization permit reliable analytical results to be obtained. A direct ICP method for determination of Al, Ca, Cd, Cu, Fe, Mg, Mn, Ni, Pb, and Zn was developed. The reliability of the method was proved by comparative analysis of routine samples by atomic absorption spectrometry. The relative standard deviation of the proposed method is in the range of s sub r = 0.5-5%, depending on the analyzed element and its concentration. (Rochester-PTT)
W86-04548

SURVEY OF LEGIONELLA PNEUMOPHILA IN WATER IN 12 CANADIAN CITIES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
R. S. Tobin, P. Ewan, K. Walsh, and B. Dutka.
Water Research WATRAG, Vol. 20, No. 4, p 495-501, April 1986. 3 tab, 47 ref.

Descriptors: *Legionella pneumophila, *Canada, *Surveys, *Potable water, Drinking water, Municipal water, Cooling water, Legionnaire's Disease, Temperature effects, Chlorine, Microbiological studies.

A survey of 12 cities across Canada was conducted in order to determine the prevalence of Legionella species in potable water and cooling tower within buildings. Legionellae were detected in 11.9% of the samples overall: 6.7% from potable water sources and 28.9% from cooling tower water. The maximum concentration of the organism was 45,000/l in one shower-water sample by culture methods. A significant difference in the isolation rate of Legionella pneumophila among cities was observed. The organism was isolated from waters at a temperature of 15-41 C and was most frequently isolated in the 20.29 C range. The concentration of free and total available chlorine in the water was not associated with legionellae recovery except that the organisms were never recovered when the free available chlorine residual exceeded 7.5 mg/l. Although L. pneumophila were low concentrations or absent in most samples, the isolated organisms were usually serogroups 1 or 6, the same serogroups that are most often implicated in legionellosis cases in Canada. (Author's abstract)
W86-04581

DEVICE FOR THE CONTINUOUS MEASUREMENT OF ALGAL PHOTOSYNTHETIC RESPONSE TO LIGHT,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
For primary bibliographic entry see Field 5C.
W86-04583

STATISTICS OF ENUMERATING TOTAL COLIFORMS IN WATER SAMPLES BY MEMBRANE FILTER PROCEDURES,
Illinois Inst. of Tech., Chicago. Pritzker Dept. of Environmental Engineering.
C. N. Haas, and B. Heller.
Water Research WATRAG, Vol. 20, No. 4, p 525-530, April 1986. 5 tab, 19 ref.

Descriptors: *Statistical analysis, *Coliforms, *Potable water, *Membrane filters, Poisson ratio, Fisher's index, Binomial distribution, Water analysis.

A commonly use assumption is that the microbial counts of a given water sample are randomly distributed according to Poisson statistics and, in particular, that replicate analyses of the same sample are so distributed. Using Fisher's index of dispersion, as well as a newly developed test, analysis of prior data on membrane filter total coliform organisms in a variety of water samples indicated that, in many cases, the assumption of Poisson statistics was incorrect, but that the data were consistent with a negative binomial distribution. This finding has significance in the interpretation of total coliform counts for regulatory as well as research purposes, and further research to delineate the responsible mechanisms is required. (Lantz-PTT)
W86-04585

DETERMINATION OF NICKEL AND COBALT IN NATURAL WATERS AND BIOLOGICAL MATERIAL BY REDUCTIVE CHRONOPOTENTIOMETRIC STRIPPING ANALYSIS IN A FLOW SYSTEM WITHOUT SAMPLE DEOXYGENATION,
Chalmers Univ. of Technology, Goeteborg (Sweden). Dept. of Analytical and Marine Chemistry.
H. Eskilsson, C. Haraldsson, and D. Jagner.
Analytica Chimica Acta ACACAM, Vol. 175, p 78-88, September 1985. 5 fig, 3 tab, 10 ref.

Descriptors: *Cobalt, *Nickel, *Trace metals, *Pollutant identification, *Potentiometers, Water analysis, Seawater, Natural waters, Heavy metals, Electrochemistry, Drinking water, Estuaries, Seawater.

The determination of trace concentrations of Ni and Co by electroanalytical stripping is described. Solutions containing Ni and Co are sucked into the thin-layer cell by a microprocessor-controlled pump. Co and Ni are potentiostatically adsorbed onto a mercury film plated onto the carbon electrode. The metals are reduced from their dimethylglyoxime complexes by a medium of calcium chloride. the microprocessor records the potential vs. time behavior of the working electrode. The mercury film is removed by mild oxidation in an iodine/iodide solution and the glassy carbon surface is cleaned with ethanol and sodium hydroxide prior to the next analysis. The Co and Ni concentrations are evaluated by means of a standard addition procedure. The method was applied to drinking, estuarine and sea water samples. The detection limits on the one sigma level after one min of potentiostatic adsorption were 9 and 11 nanograms/liter for Ni and Co, respectively. Ni and Co were determined in reference samples of bovine liver and seawater sediments after acid digestion. In order to obtain correct Co values, it is necessary to reduce Co(III) species formed during acid digestion with sodium tetrahydroborate. (Geiger-PTT)
W86-04591

CHARACTERIZATION OF SUBSURFACE BACTERIA ASSOCIATED WITH TWO SHALLOW AQUIFERS IN OKLAHOMA,
Florida State Univ., Tallahassee. Dept. of Biological Science.
D. L. Balkwill, and W. G. Ghiorse.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 580-588, September 1985. 6 fig, 5 tab, 17 ref. EPA Cooperative Agreement No. CR811148.

Descriptors: *Shallow aquifers, *Subsurface bacteria, *Oklahoma, Microscopic analysis, Light microscopy, Electron microscopy, Growth media, Aerobic bacteria, Anaerobic bacteria.

The bacterial microflora of two shallow aquifers (saturated subsurface zones) in Oklahoma was characterized by direct observation with light and electron microscopy, by plating, and by examination of colony morphology and distribution. Isolated bacterial strains were also examined. Total cell counts varied only slightly from sample to sample, whereas colony counts varied widely. Colony counts on nutritionally rich media were lower than on low-nutrient media, especially in samples from the saturated zone. The variety of colony types growing on nutritionally rich media decreased with increasing depth and saturation. Colony counts of anaerobic bacteria also decreased with depth but were at least 100-fold lower than aerobic counts on most media. Cell morphologies of bacteria grown aerobically on plates included short rods, cocci, and actinomycete-like forms. Direct light microscopic observation of sediments revealed short, rod-shaped, and coccoid bacterial cells; endospores, actinomycete spores, and eucaryotic forms were note observed by light microscopy. Electron microscopic observation of bacteria released from the samples revealed that 85 to 90% of them were coccoid, gram-positive, Arthrobacter-like organisms, some of which were dividing or contained completed division septa; other types of gram-positive and gram-negative bacteria were present in lower numbers. Isolated bacterial strains were able to grow on both nutritionally rich and low-nutrient media. Results suggest that these two shallow aquifers are dominated by aerobic, nutritionally versatile bacteria that can subsist on low concentrations of organic compounds without forming specialized resting cells. (Lantz-PTT)
W86-04664

COMPARISON OF GAUZE SWABS AND MEMBRANE FILTERS FOR ISOLATION OF CAMPYLOBACTER SPP. FROM SURFACE WATER,
Nutrition Inst., Cairo (Egypt).
M. R. el- Sherbeeny, C. Bopp, J. G. Wells, and G. K. Morris.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 611-614, September 1985. 4 tab, 18 ref.

Descriptors: *Gauze swabs, *Membrane filters, *Campylobacter jejuni, *Surface water, Filtration, Seawater, Estuaries, Freshwater, Atlanta, Georgia, Streams.

The epidemiology of Campylobacter jejuni indicates that waterborne transmission is important; the organism has been isolated from seawater, fresh water, and estuarine sites. Membrane filtration, with and without use of an enrichment broth, has been the most common method for isolating C. jejuni from water. Evaluated were two methods for isolating C. jejuni from water: membrane filtration and gauze filtration. The membrane filters evaluated included 0.22- and 0.45 micrometer-pore Millipore filters, 0.2- and 0.4 micrometer-pore Nuclepore filters, and a 0.45-micrometer pore Zetapor filter. The gauze filters included both Moore and Spira swabs. Of the membrane filters evaluated, the 0.45-micrometer-pore Millipore and Zetapor filters were the most sensitive for recovery of C. jejuni from seeded waters. The 0.45-micrometer-pore Millipore filter placed in Oosterom broth was better for recovery of C. jejuni from seeded stationary surface waters than either the Spira or Moore swab. However, use of the Spira swab has the advantage of inexpensive equipment (gauze and plastic jars), but membrane filtration is probably a more sensitive technique, especially when only small volumes of water are available. Moreover, membrane filtration does not require the use of an enrichment broth since the filter can be placed directly on a selective agar plate. Membrane filtration may be more adaptable to quantitative studies of Campylobacter spp. in water that were not done in these studies. The Moore swab was not evaluated in streams; however, its use does present logistical problems in stream sampling that make in undesirable. One must make a return trip to pick it up, and it is subject to vandalism. C. jejuni is a common contaminant of Atlanta area creeks: this study resulted in isolations from 5 of 12 (41%) streams sampled. From four of the five streams, C. jejuni was isolated on two occasions (1 to 3 weeks apart). (Lantz-PTT)
W86-04666

BACTERIAL BIOMASS, METABOLIC STATE, AND ACTIVITY IN STREAM SEDIMENTS: RELATION TO ENVIRONMENTAL VARIABLES AND MULTIPLE ASSAY COMPARISONS,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
T. L. Bott, and L. A. Kaplan.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 508-522, August 1985. 2 fig, 13 tab, 69 ref. NSF Grant No. DEB-7921963.

Descriptors: *Biomass, *Bacteria, *Metabolism, *Stream sediments, Biochemical tests, Streams, Adenosine triphosphate, Epifluorescent microscopy, Respiration, Biosynthesis, Dissolved organic matter.

Bacterial biomass, metabolic condition, and activity were measured over a 16-month period in the surface sediments of the following four field sites with differing dissolved organic matter regimes: a woodlot spring seep, a meadow spring seep, a

second-order stream, and a third-order stream. Total bacterial biomass was measured by lipid phosphate and epifluorescence microscopic counts (EMC), and viable biomass was measured by 14-C most probable number, EMC with 2-(p-iodophenyl)-3-(p-nitrophenyl) -5-phenyl tetrazolium chloride reduction, and ATP. Bacterial metabolic condition was determined from the percentage of respiring cells, poly-beta-hydroxybutyrate concentrations, and adenylate energy charge. Activity measures included 14-C-lipid respiration, from which biosynthesis was calculated. Total bacterial biomass (from EMC) ranged from 0.012 to 0.354 micrograms of C/mg of dry sediment, and was usually lowest in the third-order stream. The percentage of cells respiring was less than 25% at all sites, indicating that most bacteria were dormant or dead. Adenylate energy charge was measured only in the third-order stream and was uniformly low. Poly-beta-hydroxybutyrate concentrations were greater in the woodlot spring seep than in the second- and third-order streams. Uptake of algal lysate dissolved organic carbon ranged from undetectable levels to 166 mg of C/sq m/hr. Little community respiration could be attributed to algal lysate metabolism. Phospholipid synthesis ranged from 0.006 to 0.354 pmol/mg of dry sediment/hr. Phospholipid synthesis rates were used to estimate bacterial turnover at the study sites. An estimated 375 bacterial generations/yr, were produced in the woodlot spring seep, and 67/yr were produced in the third-order stream. (Lantz-PTT)
W86-04677

APPLICATIONS OF FLUORESCENT DYE TRACERS IN THE PLANNING AND HYDROLOGICAL APPRAISAL OF SANITARY LANDFILLS,
Bristol Univ. (England). Dept. of Geography.
For primary bibliographic entry see Field 5G.
W86-04679

5B. Sources Of Pollution

ISOTOPE TECHNIQUES IN THE HYDROGEOLOGICAL ASSESSMENT OF POTENTIAL SITES FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES.
International Atomic Energy Agency, Vienna (Austria).
Technical Reports Series No. 228, 1983. 151 p, 23 fig, 11 tab, 118 ref, 1 append.

Descriptors: *Groundwater movement, *Geochemistry, *Isotope studies, Radioactive waste disposal, Geohydrology, Waste disposal, Fate of pollutants, Tracers, Isotopic tracers, Aquifers, Deuterium, Tritium, Oxygen isotopes, Radioisotopes, Carbon radioisotopes, Uranium radioisotopes.

Natural nuclides, stable and radioactive, can be used to study the movement of water in low-permeability rocks being considered as radioactive waste repositories. The short-lived isotopes (tritium) are useful in assessing if a potential site has had recent contact with surface waters. The longer-lived nuclides (C14) and stable nuclides (018 and deuterium) can give information on the slow overall movement of the water in the bedrock. In addition, these nuclides can reveal data on rock porosity and sorption sites and on exchange of isotopes with the rock. The flow pattern in the bedrock is complex. Therefore, no single technique can produce a detailed understanding of all the processes which have led to the composition of the water sample and which have bearing on a final repository. Combined use of isotope techniques has contributed greatly to the understanding of groundwater systems. One particularly important aspect of water movement in a repository site is the presence of a fast pathway among otherwise very slow pathways. Two aspects which should be further studied are (1) diffusional exchange of species between slowly moving or stagnant water in the rock and faster moving water in the flow paths and (2) the rate of exchange in the real environment between those isotopes which are exchanged with the rock-forming minerals. (Cassar - PTT)
W86-03905

DISPERSION AND SELF-PURIFICATION OF POLLUTANTS IN SURFACE WATER SYSTEMS.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
UNESCO: Paris, France, 1982. Edited by P. G. Whitehead and T. Lack. 98 p, 23 fig, 11 tab, 118 ref.

Descriptors: *Fate of pollutants, *Water pollution effects, *Rivers, *Lakes, *Self-purification, Water pollution sources, Wastewater pollution, River flow, Flow, Oxygen balance, Oxygen demand, Aeration, Water quality control, Reservoirs, Oxidation, Sedimentation, Eutrophication, Surface water, Pollutant identification.

Information on processes which control the distribution and behavior of pollutants in water is presented to hydrologists and engineers. Pollution definitions, processes controlling pollution, and pollutant measurements are described in the introductory chapter. Types of pollutants and their sources (point or diffuse) and effects are listed. The main sources are community wastewater, industrial wastewater, agricultural activity, the atmosphere, highway drainage, and landfill leachates. The physical, chemical, and biological aspects of processes affecting water quality in rivers and in lakes are discussed. Among these topics are physical and hydraulic behavior, self-purification and the oxygen balance, prediction of water quality, and biotic changes by pollutants. (Cassar - PTT)
W86-03906

ACID DEPOSITION: EFFECTS ON TERRESTRIAL ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
D. S. Shriner.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE83-001967, Price codes: A02 in paper copy, A01 in microfiche. CONF-821058--1, (1983). 3 p. Electric Power Research Institute Project RP 1908-2, DOE Contract W-7405-eng-26.

Descriptors: *Acid rain, *Air pollution, *Agriculture, Air pollution effects, Forestry, Ecosystems, Economic aspects, Nutrients, Cycling nutrients, Environmental effects.

Acidic precipitation is frequently cited as a potential threat to agricultural and forest productivity. To date, however, conclusive evidence of agricultural losses due to ambient levels of acidic precipitation has been lacking. Potential mechanisms for an effect, however, exist. They include the direct effect on aerial portions of the plant. Visible injury thresholds for vegetation exposed to acid precipitation lie between pH 2.0 and 3.6. Visible injury appears to be related to total loss of hydrogen ions. Concern for forest ecosystems pertains to both direct effects of acid on the plants, and indirect effects on nutrient cycling and availability. (Halterman - PTT)
W86-03908

RESULTS OF 4-M3 LNG SPILLS ONTO WATER,
Lawrence Livermore National Lab., CA.
D. L. Ermak, H. C. Goldwire, W. J. Hogan, R. P. Koopman, and T. G. McRae.
Available from the National Technical Information Service, Springfield, VA. 22161 as DE82-016253, Price codes: A03 in paper copy, A01 in microfiche. UCRL--87640, (1982). 29 p, 4 tab, 8 ref. DOE Contract W-7405-ENG-48.

Descriptors: *Environmental effects, *Ecological effects, *Natural gas, Hazardous materials, Hazards, Accidents, Ecosystems, Aquatic environment, Vaporization.

Lawrence Livermore National Laboratory (LLNL) is conducting safety research under the sponsorship of the U.S. Department of Energy (DOE) to determine the possible consequences of liquified natural gas (LNG) spills. The LLNL program includes both the collection of data from various size experiments and development of an ensemble of computer models to make predictions for conditions under which tests cannot be performed. In spills of 40 cu m of liquified natural gas onto water done at the Naval Weapons Center (NWC), China Lake, California in 1980 and 1981, data was collected on gas cloud dispersion and combustion and rapid phase transition (RPT) explosions. Analysis of the data from these tests, including comparisons between the predictions of various models and the data, are presented. The results suggest that large-scale spills may be more hazardous than would have been predicted based on earlier small-scale tests. (Author's abstract)
W86-03909

INVESTIGATION OF THE WATER QUALITY AND POLLUTION IN THE RIVERS OF THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
W. Jinghua, and L. Yongke.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 361-371, 4 fig, 4 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Water quality, *China, Diversion, Environmental effects, Canals, Irrigation, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the water quality of the rivers involved was investigated. At present, the water quality of the Chang Jiang is good. Some pollution, such as phenol and heavy metals, is observed downstream from some cities. Similarly, the Huai He drainage basin is only subject to pollution in the vicinity of industrial cities and towns. Although the Huang He River gets high pollution loads from several cities, self-purification rates are very high. The Hai He basin is polluted by industrial cities, resulting in high phenol, chromium and mercury concentration. The most fundamental measure to solve the problem of protecting the source of the water transfer is to strengthen the control over the pollution sources. River pollution monitoring should be improved, and monitoring points should be established along the main conveyance routes. (Halterman - PTT)
W86-03944

RADIOACTIVE AND CHEMICAL WASTE MIGRATION IN THE SNAKE RIVER PLAIN AQUIFER, IDAHO NATIONAL ENGINEERING LABORATORY,
Geological Survey, Reston, VA.
J. B. Robertson.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with examples of their Application, The UNESCO Press: Paris, France, 1982. p 97-122, 13 fig, 12 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Radioactive waste, *Model studies, Solute transport, Groundwater movement, Aquifers, Chemical wastes, Industrial wastes, Waste disposal, Idaho National Engineering Laboratory, Snake River.

The groundwater regime in the Idaho National Engineering Laboratory area was simulated with a numerical model to better understand migration patterns of radioactive and chemical waste at the site. Predictions of chloride, tritium, and Sr90 under various conditions were made up to the year 2000. However, the effects of several important, unpredictable variables, such as the recharge from the Big Lost River, require that the results, especially long-term results, be interpreted with care. Other sources of error are vertical dispersion, possible large withdrawals, and errors in parameters. However, general extent of the plumes can be plotted. In general the tritium plume was similar to that of chloride, except in the western section, where the source of tritium is larger. Recharge from the Big Lost River tends to accelerate the

southerly movement of the plume and divert it more to the southeast. (Cassar - PTT)
W86-03983

ASSESSMENT OF EXPLOITABLE GROUND-WATER RESOURCES IN FISSURED-KARSTIC FORMATIONS IN THE SERGA RIVER VALLEY (SERGINSKOE AQUIFER, URAL),
Vsesoyuznyi Nauchno-Issledovatel'skii Inst. Gidrogeologii i Inzhenerdoi Geologii, Moscow (USSR).
For primary bibliographic entry see Field 2A.
W86-03986

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).
American Petroleum Inst., Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04001

DISPERSION OF CHEMICALLY TREATED CRUDE OIL IN NORWEGIAN OFFSHORE WATERS,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
For primary bibliographic entry see Field 5G.
W86-04003

ENHANCED OIL BIODEGRADATION: A NEW OPERATIONAL TOOL TO CONTROL OIL SPILLS,
Elf Aquitaine, Pau (France).
For primary bibliographic entry see Field 5G.
W86-04016

ECOLOGICAL MAPPING AND CLEANUP OF OIL SPILLS ONSHORE,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
T. Klokk, A. Danielsen, E. Sendstad, and P. Tommeraas.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas, p. 165-169, 7 fig, 9 ref.

Descriptors: *Ecological effects, *Oil spills, *Cleanup operations, *Mapping, Oil pollution, Environmental effects, Oil, Norway.

An ecological mapping project aims at mapping in advance areas along the Norwegian coast most likely to be exposed to oil spills from off shore oil activities. Up to now, the southernmost parts of the coast as well as those parts along the northern coast most likely to be subject to oil spills from possible wells at the Haltenbanken, Traenabanken and Tromsoflaket have been mapped. Oil originating from a blowout at the northern oilfields is likely to reach the coast in a few days. This stresses the necessity and demand for locality information in a surveyable and operative form. The maps provide information about areas with respect to natural resources, and their value for nature conservation reasons, industrial utilization, or development. Among parameters recorded on the maps are geomorphological beach types and important geological, zoological and botanical localities. Further, seabird species, seals, local fishing places and important resorts or outdoor life areas are mapped. The mapping of areas for pelagic fish species, as well as localities for fish farming and storage in the sea of live catches, has been a subject of major concern. The geomorphological types are correlated to anticipated self-cleaning ability. A matrix for prioritizing localities with respect to cleanup actions also is presented. This implies quantifying each locality with regard to its biological, commercial, and outdoor life importance and self-cleaning ability. (Author's abstract)
W86-04018

SHORELINER EXPERIMENTS AND THE PERSISTENCE OF OIL ON ARCTIC BEACHES,
Woodward-Clyde Consultants, Victoria (British Columbia).
E. H. Owens, J. R. Harper, C. R. Foget, and W. Robson.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 261-268, 7 figs, 5 tabs, 14 refs.

Descriptors: *Oil spills, *Cleanup operations, *Experimental data, Beaches, Cold regions, Oil pollution, Oil.

Experiments associated with the oiling of beaches in an arctic environment show that fetch and wave-energy conditions at the shoreline are primary factors in determining the persistence of stranded oil. Five intertidal sections of coast were oiled, each of which differed in terms of shoreline exposure and fetch. The oil loadings of the test beaches that were oiled artificially were in the same ranges as those from an adjacent nearshore spill, so that the experimental results can be assumed to replicate real-world oiling conditions. On the most exposed beach (fetch 90 kilometers) all oil was removed naturally after 80 days of exposure to open-water conditions. At a semi-exposed location, 85 to 95 percent of the oil was removed within 40 days, and at the most sheltered test sites (fetch less than 2 km) between 5 and 30 percent of the oil remained after an observation period of 160 open-water days. Data collection to determine fates of oil at the different sites over a four-year period is continuing. In this relatively low-energy wave climate environment, with an open-water season of about 60 days, most exposed beaches would be cleaned naturally to levels less than 500 milligrams/kilogram within 100 days, but where the fetch is less than 10 to 25 km the expected persistence of oil stranded in the intertidal zone could be greater than 10 years. (Author's abstract)
W86-04023

REVIEW OF THE STATE-OF-THE-ART OF OIL SPILL FATE/BEHAVIOR MODELS,
Raytheon Co., Portsmouth, RI. Submarine Signal Div.
For primary bibliographic entry see Field 5G.
W86-04026

FATE OF TWO LARGE OIL SPILLS IN THE ARABIAN GULF,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
W. J. Lehr, and M. S. Belen.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 377-380, 6 fig, 9 ref.

Descriptors: *Oil spills, *Modelling, *Distribution patterns, *Fate of pollutants, Environmental effects, Oil, Oil recovery, Coastal impact, Arabian gulf, Bahrain, Qatar, Case studies, Path of pollutants.

In August and October 1980, two large oil spills occurred in the Arabian Gulf. The first, from an unidentified source, involved about 20,000 barrels of crude oil and impacted the entire north and west coasts of the island nation of Bahrain. The second occurred when the Ron Tapmeyer platform in the Hasbah offshore oil field blew out, releasing an estimated 50,000 barrels of thick crude into the Gulf. The spill subsequently covered large sections of the coastline of Qatar. The fate of the oil from these spills is examined with respect to the unique conditions found in the region. A computer model is used for trajectory analysis of the spills and hypothesizing the possible origin of the first spill. Methods of cleanup and problems with the weathered oil are mentioned. The environmental damage caused by the Bahrain spill is assessed. (Author's abstract)
W86-04030

HASBAH 6 (SAUDI ARABIA) BLOWOUT: THE EFFECTS OF AN INTERNATIONAL OIL SPILL AS EXPERIENCED IN QATAR,
Shell International Petroleum Mij., The Hague (Netherlands).
For primary bibliographic entry see Field 5C.
W86-04031

MULTIVARIATE ANALYSIS OF PETROLEUM HYDROCARBON WEATHERING IN THE SUBARCTIC MARINE ENVIRONMENT,
Science Applications, Inc., La Jolla, CA. Environmental Sciences Div.
J. R. Payne, B. E. Kirstein, G. D. McNabb, J. L. Lambach, and C. Oliviera.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 423-434, 10 fig, 5 tab, 20 ref.

Descriptors: *Hydrocarbons, *Multivariate analysis, *Cold regions, *Fate of pollutants, *Oil spills, Weathering, Arctic, Marine environment, Modelling, Oil, Cold regions.

When crude oil or petroleum products are released to the marine environment, immediate alterations in chemical and physical properties occur as a result of a variety of weathering processes. A three-year oil weathering study of Prudhoe Bay crude oil has been completed under ambient subarctic conditions at the National Oceanic and Atmospheric Administration's lower Cook Inlet field laboratory in Ksaitsna Bay, Alaska. Quantitative data from outdoor ware-tank and flow-through aquaria systems were collected on seasonal and time-series measurements of compositional changes in the oil and water column due to evaporation, dissolution, and water-in-oil emulsification, as well as alterations in rheological properties of the slick. These data are used for mathematical model development and verification of computer predicted oil weathering behavior from a variety of spill scenarios. The oil-weathering mathematical models developed in this program are based on measured physical properties data, and they generate material balances for both specific compound and pseudo-compounds (distillation cuts) in crude oil. These models are applicable to open-ocean oil spills, spills in estuaries and lagoons where the water column is finite, and spills on land. The oil weathering processes included in the mathematical model are evaporation, dispersion of oil into the water column, dissolution, water-in-oil emulsification (mousse formation), and oil slick spreading. In most cases, very good agreement is obtained between predicted and observed weathering behavior. The material balance and weathered-oil composition predictions generated as a function of time have been very useful in providing information for contingency planning, estimating potential damage assessments and preparing environmental impact reports for outer continental shelf drilling activities. (Author's abstract)
W86-04034

BIOS PROJECT: AN UPDATE,
Environmental Protection Service, Edmonton (Alberta).
P. J. Blackall, and G. A. Sergy.
In: Proceedings of the 1983 Oil Spill conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 451-455, 2 fig, 2 tab, 7 ref.

Descriptors: *Path of pollutants, *Fate of pollutants, *Water pollution effects, *Oil spills, *Dispersants, *Distribution patterns, *Cleanup operations, Oil recovery , Oil pollution, Chemical analysis, Biological properties, Oil, Baffin Island Oil Spill(BIOS).

The Baffin Island Oil Spill (BIOS) Project, formally begun in March 1980, now is entering the fourth and final year of the planned field work. The primary objectives of this internationally funded project are to: (1) determine if the use of chemical dispersants in the arctic nearshore will reduce or increase the environmental effects of spilled oil, (2) assess the fate of oil, and (3) compare the relative effectiveness of other shoreline protection and cleanup techniques. This paper provides an over-

view of studies sponsored by the BIOS Project during the first three field seasons. Highlighted are the major oil releases which involved a total of 40 cubic meters of medium gravity crude oil. In addition, the preliminary results of the pre- and post-spill physical, chemical, and biological studies are presented. The physical program studies predicted the proper time and location for the oil releases and monitored the subsequent physical fate and behavior of the oil. The chemical program studies monitored the pre- and post-spill hydrocarbon levels in the water, sediments, and tissue of selected macrobenthic species, and also the environmental chemistry of the study area. The biological program studies to date have characterized the macrobenthic floro and fauna, the microorganisms, and the shorter-term effects of the oil releases on the subtidal biota. The potential ramifications of the BIOS Project's results on future oil spill countermeasure strategies are discussed. (Author's abstract)
W86-04035

LONG-TERM FATE OF DISPERSED AND UNDISPERSED CRUDE OIL IN TWO NEARSHORE TEST SPILLS,
Bowdoin Coll., Brunswick, ME.
For primary bibliographic entry see Field 5C.
W86-04037

ISOLATION AND GROWTH OF 'NATURALLY OCCURRING' BACTERIA FROM GROUND WATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
For primary bibliographic entry see Field 2F.
W86-04049

BIODEGRADATION OF HALOAROMATIC SUBSTRATES IN A SHALLOW ANOXIC GROUND WATER AQUIFER,
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
For primary bibliographic entry see Field 5D.
W86-04050

SORPTION OF ORGANIC SOLUTES: COMPARISON BETWEEN LABORATORY-ESTIMATED RETARDATION FACTORS AND FIELD OBSERVATIONS,
Stanford Univ., CA. Dept. of Civil Engineering.
G. Curtis, P. Roberts, and M. Reinhard.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 35-38, 4 fig, 4 tab, 12 ref. Contract No. CR-808851.

Descriptors: *Sorption, *Organic compounds, *Experimental data, *Path of pollutants, *Retardance, Aquifers, Groundwater, Retardants, Carbon tetrachloride, Bromoform, Tetrachloroethylene, 1,2-Dichlorobenzene, Hexachloroethane.

This work presents the results of laboratory experiments developed to measure sorption distribution coefficients for five organic solutes and aquifer materials. The aquifer material was excavated from the site of a field experiment, where the transport of halogenated organic solutes under natural conditions is being studied. The solutes used in the field study, carbon tetrachloride, bromoform, tetrachloroethylene, 1,2-dichlorobenzene and hexachloroethane, were also used in the laboratory experiments. Isotherms measured for these solutes in the concentration up to 0.08 g.m(-3) were linear and had near zero intercepts. Retardation factors inferred from the isotherms for carbon tetrachloride, bromoform and tetrachloroethylene were within the range of retardation factors observed in the field. The rank order of the distribution coefficients was in agreement with the solutes' octanol water partition coefficients. (Author's abstract)
W86-04051

SORPTION KINETICS OF TOXIC AND HAZARDOUS ORGANIC SUBSTANCES ON NEW JERSEY COASTAL PLAIN AQUIFER SOLIDS,
Cook Coll., New Brunswick, NJ. Dept. of Environmental Science.
J. Katz, and C. G. Uchrin.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 44-46, 4 fig, 11 ref.

Descriptors: *Sorption, *Kinetics, *Organic pollutants, *Aquifers, *Path of pollutants, Soil chemistry, Soil properties, Chloroform, Benzene, 1,1,2-trichloroethanes, Trichloroethylene, New Jersey.

Studies examining the sorptive characteristics of selected organic pollutants to representative soil samples from New Jersey aquifers are described. The soil from the Cohansey aquifer is a sand with a small organic fraction. Equilibrium studies examining lindane exhibited a linear adsorption isotherm with an association constant 0.013 l/g. Desorption isotherms indicated a pronounced hysteresis, indicating that the sorption process for this system is not completely reversible. (Author's abstract)
W86-04052

EVALUATION OF PARTITIONING PROCESSES FOR ORGANIC CONTAMINANTS IN GROUND WATER,
Michigan Univ., Ann Arbor. Dept. of Environmental and Water Resources Engineering.
C. T. Miller, and W. J. Weber.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 47-49, 4 fig, 2 tab, 7 ref.

Descriptors: *Sorption, *Groundwater pollution, *Organic compounds, Groundwater, Evaluation, Sorption kinetics, Sorption equilibria, Water pollution, Path of pollutants.

Extensive contamination of the ground water resources of the U.S. by organic pollutants has precipitated a need to evaluate the movement and fate of these substances. This, in turn, has led to the development of models for simulating contaminant transport and transformation processes in ground water systems. One of the most important of these processes for organic contaminants is sorption on aquifer soils. Sorption is a dominant process for many organic solute soil systems, one which may retard the movement of the solute to a rate which is orders of magnitude less than that of the water itself. Accurate description of sorption is a requisite for transport analysis in such systems. Description of sorption processes must include the characterization of equilibrium, the approach to equilibrium and sorptive hysteresis which may occur in the sorption-desorption of organic solutes in ground waters. (Author's abstract)
W86-04053

GROUNDWATER CONTAMINATION AT CONROE WASTE DISPOSAL SITE,
Rice Univ., Houston, TX.
T. H. Wang, C. M. Curran, P. B. Bedient, and M. B. Tomson.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 50-52, 3 tab.

Descriptors: *Groundwater pollution, *Path of pollutants, *Organic wastes, *Inorganic compounds, *Texas, Aromatic hydrocarbons, Phenolics, Heterocyclic compounds, Groundwater, Water pollution, Conroe Waste Disposal Site.

Ground water contamination at the Conroe waste site, Texas, has been investigated for the past two years. The concentrations of trace level organics (TLOs), inorganics, and metals in ground water were analyzed. Major organic constituents detected were polynuclear aromatic hydrocarbons, phenolics, and nitrogen- and sulfur-heterocyclic compounds. Depth to water, conductivity, chloride, pH, and dissolved oxygen were monitored to indicate possible degradation and migration of contaminants in ground water. Various water sampling, laboratory procedures, and GC identification methods for TLOs were evaluated. A Teflon bailer was used in water sampling for its rigidity and inertness. Sep-Pak extraction procedures have the advantages of simplicity and versatility in the sample preparation and have shown better reliability and less cross contamination than conventional liquid-liquid extraction procedures. The reproducibility and recovery efficiency of fourteen target organic compounds selected in this study were from good to excellent. Leaching of TLOs from soil into ground water was examined. The results indicated that the amount of TLOs absorbed by soil was significantly higher than the amount leached into ground water. The major organic compounds found in the water soluble fraction of Conroe pit soil were pentachlorophenol and higher molecular weight alkanes. Based on the analytical data and overall variation of results due to field sampling, extraction procedure, and GC analysis, we conclude that the concentrations of TLOs in ground water have remained unchanged for the past two years. (Author's abstract)
W86-04054

IRREVERSIBLE SORPTION OF TRACE LEVEL ORGANICS BY GROUND WATER HUMIC SUBSTANCES: A NEW MECHANISM OF TRANSPORT,
Rice Univ., Houston, TX.
C. C. West, M. B. Tomson, and G. G. Waggett.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 53-54, 12 ref.

Descriptors: *Sorption, *Path of pollutants, *Organic compounds, *Groundwater movement, *Humic material, Hexachlorobenzene, Soil chemistry, Groundwater, Soil columns.

Soil column experiments exhibited mediated transport of hexachlorobenzene (HCB) by a ground water humic material (HM). The retardation equation was modified to include transport of a dissolved HCB/humic complex in the mobile aqueous phase in an attempt to account for the mediated transport. Results indicate that dissolved organic matter can form an irreversibly bound complex with hexachlorobenzene which is mobilized in soil column and represents a new mechanism by which ground waters can be contaminated. (Lantz - PTT)
W86-04055

ORGANIC SOLUTE TRANSPORT IN GROUNDWATER DISCHARGE ENVIRONMENTS,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
S. L. Winters, and D. R. Lee.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 55-58, 9 fig, 4 tab, 10 ref.

Descriptors: *Organic compounds, * Path of pollutants, *Groundwater pollution, *Solute transport, Groundwater movement, Trace organics, Groundwater, Water pollution, Tritium, Napthalene, Municipal wastes, Aquifers.

The advective flux of organic pollutants to surface waters from contaminated groundwater was measured using an in situ column technique. These columns are 20-cm diameter, 30-cm long cylinders that are inserted vertically in shallow-water sediments known to be receiving groundwater. A tracer mixture, e.g., tritium and naphthalene, is injected into a screened disc at the column base. A sampling tube near the column top permits tracer monitoring over time. This study was prompted by the observation that trace organics travel hundreds of meters from municipal waste sites through sandy aquifers to nearby surface waters yet no device existed to monitor this pollutant influx. The in situ column was field tested by determining the sorption behavior of 14C-labelled naphthalene at concentrations less than 0.01% of its water solubility. Results show that it is practical using in situ columns to determine retardation factors for selected organics in groundwater discharge environments such as stream beds. Preliminary tracer test data show naphthalene retardation about one-fifth

that predicted from its n-octanol/water partition coefficient and the organic carbon fraction of the sediments. (Author's abstract)
W86-04056

GEOCHEMICAL INVESTIGATIONS INTO GROUNDWATER POTENTIAL CONTAMINANTS RESULTING FROM UNDERGROUND COAL GASIFICATION (UCG),
Ground Water Sampling, Inc., Englewood, CA.
A. M. Behi, and G. G. Hunkin.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 65-68, 4 fig, 9 ref.

Descriptors: *Groundwater pollution, *Underground coal gasification, *Organic compounds, *Inorganic compounds, *Geochemistry, Organic wastes, Benzene, Toluene, Phenols, Aquifers, Chemical analysis, Groundwater, Sulfate, Ammonia, Barium, UCG.

UCG is a process by which subbituminous coal is pyrolyzed in situ and the product gas is recovered above the ground. The process involves thermal decomposition of coal and other rock material immediately surrounding the coal stratum. Ash, tar, charcoal and pyrometamorphic materials are produced, and inorganic minerals along with organic gases are liberated and released into the surrounding coals, which are fractured, saturated and form a component of the groundwater system. The vaporized organic gases condense to form pollutants including phenols and pyrines, which are subsequently absorbed by the reactive surfaces of the decomposed coal products. Aromatics, such as benzene and toluene, move faster in groundwater than the heavier molecular weight organics. Both parameters show erratic distribution in post-burn groundwater samples. Phenols were not found in high concentrations. Several years after test gasifications were terminated, most of the parameters, excluding sulfate, have returned to pre-test levels. If the high sulfate condition can be dealt with, long term detrimental effects can be discounted. Groundwater contamination from UCG operations is site specific and depends on original coal chemistry, overburden rock composition, aquifer characteristics, and hydrologic and geologic controls. Chemical studies showed high post-test concentrations of sulfate, ammonia, conductivity, barium, total organic carbon, chemical oxygen demand, calcium, and organics. All these parameters, except sulfate, decrease to pre-test levels with time. (Lantz - PTT)
W86-04058

DISTRIBUTION OF SELECTED TRACE ORGANICS IN THE LEACHATE PLUME OF A MUNICIPAL LANDFILL,
Stanford Univ., CA. Dept. of Civil Engineering.
M. Reinhard, J. W. Graydon, N. L. Goodman, and J. F. Barker.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 69-71, 3 fig, 20 ref. Contract No. R-808851.

Descriptors: *Leachates, *Municipal landfills, *Organic compounds, *Groundwater pollution, *Plumes, Landfills, Waste dumps, Aromatic hydrocarbons, Aliphatic acids, Aromatic acids, Trichloroethylene, 1,4-dichlorobenzene, North Bay, Ontario.

In the leachate plume of the municipal landfill of North Bay, Ontario, the distribution of trace organics, such as petroleum-derived aromatic hydrocarbons, chlorinated solvents, and aliphatic and aromatic acids, has been analyzed. Chloride was used as a conservative tracer. The input into the 800 m long plume was evaluated at a multi-level observation well near the boundary of the landfill by analyzing 5 samples over a two-year period. The chloride concentration remained relatively constant (+ or - 20%) relative to the aromatic hydrocarbon concentrations, which varied by almost an order of magnitude. However, the concentration ratios of the individual hydrocarbon compounds remained relatively constant. The measured concentrations were in the low microgram/L range, approximately three orders or magnitude below the solubility limit of the compounds. Trichloroethylene (Cl3EY) has been detected at the microgram/L level beneath the plume, and at the bottom of the aquifer, but not in the anaerobic plume, while 1,4-dichlorobenzene was detected throughout the plume indicating both stability and mobility of this compound under anaerobic conditions. The petroleum-derived aromatic hydrocarbons showed a mixed behavior, suggesting that selective and variable attenuation may have been effective. (Author's abstract)
W86-04059

FACTORS INFLUENCING THE SURVIVAL OF VIRUSES IN GROUND WATER,
Arizona Univ., Tucson. Dept. of Microbiology and Immunology.
M. V. Yates, C. P. Gerba, and L. M. Kelley.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 72-73, 2 fig, 2 tab, 8 ref.

Descriptors: *Groundwater, *Viruses, *Groundwater pollution, MS-2, Bacterial viruses, Poliovirus, Echovirus, Biological analysis, Chemical analysis.

Although ground water accounts for only approximately 20% of the nation's water supply, 50% of all waterborne disease outbreaks in the United States are due to contaminated ground water. More than half of these cases of illness are believed to be caused by enteric viruses. Little, however, is known about the persistence of these organisms in ground water. This study investigated the persistence of a bacterial virus, MS-2, and two animal viruses, Poliovirus-1 and Echovirus-1, in ground water samples collected from throughout the United States. Each virus was innoculated into separate, sterile polypropylene containers of ground water and incubated in the laboratory at the characteristic temperature of the source. Duplicate experiments were performed using the natural ground water and ground water that had been filtered to remove bacteria. Subsamples were assayed at predetermined intervals over a 30-day period. Several chemical characteristics were determined for each ground water tested. Ground water temperature was the only water characteristic found to be significantly correlated with the persistence of all three viruses. There were no consistent trends found in the ability of any of the viruses to persist in the presence or absence of the indigenous bacteria. (Author's abstract)
W86-04060

SALINE CONTAMINANTS IN THE GROUNDWATERS OF EASTERN SAUDI ARABIA,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Dept. of Civil Engineering.
R. al-Layla, and R. L. Dejong.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 85-87, 15 ref.

Descriptors: *Groundwater pollution, *Coastal aquifers, *Saline water intrusion, Saline water, Intrusion mechanisms, Groundwater, Saudi Arabia.

Intensive development along a coastline, with consequent rapidly increasing use of local groundwater supplies in the absence of adequate surface resources, invariably leads to intrusion of saline water into the coastal aquifers and the destruction of their water supply potential. Conditions along the Gulf Coast of Saudi Arabia are favorable towards such a chain of events, although for a number of reasons no large-scale intrusion has yet been observed. This paper reviews the basic intrusion mechanisms, and describes the development patterns as well as the hydrogeologic setting of the Eastern Province. On this basis conclusions are drawn concerning existing, and potential saline intrusion problems along the Arabian Gulf coast and suggestions are made for corrective and preventive measure to be taken. (Author's abstract)
W86-04062

MODELING GROUND WATER TRANSPORT AT CONROE CREOSOTE WASTE SITE,
National Center for Ground Water Research, Norman, OK.
R. C. Borden, P. B. Bedient, and T. Bouvette.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 88-90, 4 fig, 2 tab, 7 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Monitoring, *Water quality, Groundwater pollution, Modeling, Organic compounds, Inorganic compounds, Conroe, Texas, Conroe Creosote Waste Site.

Results from three years of monitoring water quality including organic and inorganic compounds at Conroe, Texas waste site were used to direct simple 1-D and 2-D transport modeling efforts. The U.S. Geological Survey Method of Characteristics Model was used to simulate ground water flow and chloride transport from the Conroe site. Sensitivity analyses were performed on parameters which most affect the plume pattern, including hydraulic conductivity, and the height of the waste pond. 'Best fit' combinations of parameters are produced to show the difficulties of matching field data to numerical model results. Retardation of organic and simple, linear decay due to microbial activity were investigated from available coefficients derived for the Conroe site. Sensitivity of the various coefficients is evaluated in a simple 1-D mode, but such results should be useful in extrapolating such reactions to more realistic 2-D situations. (Author's abstract)
W86-04063

GEOHYDROLOGY SURROUNDING A POTENTIAL HIGH LEVEL NUCLEAR WASTE REPOSITORY IN THE PALO DURO BASIN, TX,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
For primary bibliographic entry see Field 2F.
W86-04064

ADVECTION AND RETARDATION IN AN EXPERIMENTAL PLUME OF SORBING AND NON-SORBING SOLUTES,
Stanford Univ., CA. Dept. of Civil Engineering.
D. L. Freyberg.
In: Second International Conference on Ground WAter Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 95-97, 4 fig, 1 tab, 4 ref. Contract No. CRT-808851.

Descriptors: *Plumes, *Experimental Data, *Sorption, *Path of pollutants, Advection, Retardance, Groundwater, Chloride, Tracers, Carbon tetrachloride, Modeling, Organic compounds.

Values of the zeroth and first spatial moments of the plumes of four sorbing and one non-sorbing solute have been estimated from a spatially and temporally detailed data set collected during the first 410 days of an ongoing groundwater experiment. While still preliminary, these estimates indicate that chloride is behaving as a tracer, with no loss of mass in solution, and is moving with a mean velocity of 9.5 cm/day along a straight line trajectory parallel to the local hydraulic head gradient. Of the four organic solutes, only carbon tetrachloride is behaving as a linearly-retarded, sorbing solute. The other organics are characterized by decreasing mass in solution and decreasing mean velocity, although they are following the same trajectory as the chloride and carbon tetrachloride plumes. Estimated retardation factors for carbon tetrachloride range from 1.6 to 2.1. (Author's abstract)
W86-04065

CONTRIBUTIONS TO THE FATE OF UNDERGROUND ORGANIC CONTAMINANTS DURING UNDERGROUND PASSAGE,

Bundesgesundheitsamt, Berlin (Germany, F.R.). Inst. fuer Wasser-, Boden- und Lufthygiene.
P. Friesel, G. Milde, and B. Steiner.

In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 98-100, 5 tab, 10 ref.

Descriptors: *Groundwater pollution, *Fate of pollutants, *Groundwater movement, *Modeling, *Water pollution control, Projections, Sorption, Water pollution, Groundwater.

To devise protection measures for groundwater catchment areas and to establish dimensions of treatment systems including underground passage or sand filtration for surface waters, in which more and more organic micropollutants are found, a systematic approach to investigate elimination processes in soils and similar systems has become a practical necessity. At present a more promising strategy for prediction purposes seems to lie in the development of concepts for the mechanisms of elimination. For these the main geological and compound parameters can be measured or estimated. Evaluation of recovery rates of elimination processes during underground passages in natural systems did not give results useful for prediction purposes. Better results might be attained if the complexity of each system could be accounted for, and processes could be modeled with the necessary resolution. However, this would be tedious and costly. With respect to sorption processes the methods of estimation are at hand, in the future more data should be collected on sorptive behavior of compounds with differing properties. With these, compound class specific equations to calculate the organic carbon:dissolved carbon partition coefficient can be developed. They may allow the development of equations more universally applicable by incorporation of further compound parameters beside water solubilty; for this purpose theoretical approaches, e.g., the solvophobic theory, may be useful. At least for the numerous cases of environmental pollution by chlorinated hydrocarbons - solvents, PCB, TCDD - the impact on groundwaters can be assessed with the methods available. (Lantz-PTT)
W86-04066

ASSESSING THE QUALITY OF GROUNDWATER NEAR A COASTAL PLAIN USED FOR AGRICULTURE AND DISCHARGE OF SEWAGE,

Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, and S. Lau.

In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 101-104, 1 fig, 3 tab, 12 ref.

Descriptors: *Groundwater quality, *Groundwater pollution, *Waste disposal, *Wastewater disposal, Biological analysis, Chemical analysis, Bacteria, Viruses, Chloride, Water treatment.

The purpose of this investigation was to obtain representative groundwater samples by pumping out large volumes of well water and to analyze these samples for indicator bacteria, human enteric viruses and selected chemicals. Moreover, to assess the probability that the practice of discharging sewage effluent into the unlined ditch could result in the contamination of the groundwater with sewage-borne bacteria and viruses. The quality of groundwater from a new well dug near the coastal plain on Oahu was determined by pumping out 271,500 gallons of water over 1.5 days and analyzing 9 representative samples. No fecal coliforms (<1/100 ml) and only 1.6 fecal streptococcus/100 ml were recovered in the 9 samples. In addition, no human enteric virus was recovered in the four 100-gallon samples, indicating that the groundwater was not contaminated with sewage. One and three foot soil percolates collected under the ditch which transported sewage near the well were similarly analyzed and the results indicated that it would be most unlikely for sewage-borne bacteria and viruses in the effluent to percolate through the soil profile to contaminate the groundwater. The groundwater was also analyzed for 11 chemicals. The concentration of total dissolved solids (750 mg/l) was the only measurement which exceeded the maximum contaminating level (MCL) for drinking water, although the concentration of chloride (241 mg/l) closely approximated its MCL. Blending of this groundwater with high groundwater is a viable alternative of increasing the volume of potable water required for urban expansion. (Lantz-PTT)
W86-04067

ONE-DIMENSIONAL MATHEMATICAL MODEL OF VIRUS TRANSPORT,

Holzmacher, McLendon and Murrell, Melville, NY.
P. W. Grosser.

In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 105-107, 4 fig, 7 ref.

Descriptors: *Viruses, *Groundwater pollution, *Path of pollutants, Groundwater movement, Modeling, Septic tanks, Pumping, Aquifers.

Considerable field work has been performed regarding the fate and transport of viruses within groundwater systems. This paper presents a one-dimensional groundwater flow-mass transport model representing the migration of viruses from a septic system to a private water supply well. Ultimately, the model is designed to determine adequate separation distances between sewage disposal systems and water supply wells. Inputs to the model consist of separation distance between well and septic system, pumping rate of well, aquifer characteristics, adsorption coefficient for the virus and inactivation coefficient for the virus. The model outputs are relative virus concentrations at various points downstream of the septic system at different times until steady state is reached. Published values of adsorption coefficients and viral inactivation coefficients for soils and water quality conditions similar to those encountered on Long Island, New York, were utilized as model inputs. From this data and subsequent sensitivity analyses, reasonable conclusions can be drawn regarding the extent of virus transport in the subsurface conditions of Long Island. This paper primarily focuses on the development of the mathematical representation of the mass transport, adsorption and viral inactivation processes and their natural variability. (Author's abstract)
W86-04068

APPLICATION OF MULTI-PHASE FLOW THEORY AT A CHEMICAL WASTE LANDFILL, NIAGARA FALLS, NEW YORK,

Little (Arthur D.), Inc., Cambridge, MA.

For primary bibliographic entry see Field 5G.
W86-04069

MODELLING OF NITROGEN REMOVAL IN THE VADOSE ZONE,

Murdoch Univ. (Western Australia). School of Environmental and Life Science.
G. E. Ho, K. Mathew, and P. W. G. Newman.

In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 112-114, 1 fig, 2 tab, 10 ref.

Descriptors: *Denitrification, *Vadose water, *Modelling, *Nitrogen removal, Secondary wastewater, Wastewater treatment, Ammonium, Biodegradation, Infiltration, Bacteria, Groundwater.

Ammonium in secondary wastewater is removed in the vadose zone when wastewater is applied to spreading basins with alternate flooding and drying. The processes involved in the removal of ammonium nitrogen are adsorption of ammonium by the soil, oxidation of the adsorbed ammonium to nitrate by nitrifying bacteria in the subsequent drying period thus freeing adsorption sites in the soil for further ammonium adsorption, and reduction of nitrate to nitrogen gas by denitrifying bacteria during flooding. The extent of nitrogen removal is governed by the rate of infiltration, the lengths of the flooding and drying periods, the adsorption capacity of the soil for ammonium and the rates of nitrification and denitrification. A model incorporating these processes has been developed, which can be used to explain why nitrogen removal does not take place in some wastewater rapid-infiltration systems, why nitrogen conversion stops after the nitrification state in some cases, and to calculate the extent of nitrogen removal as a function of soil type and operating conditions. The model shows that the approach to steady state after a change in operating conditions is reached only slowly. The model parameters have been obtained experimentally under laboratory conditions. A case study of nitrogen removal from wastewater by rapid infiltration in Perth, Western Australia is discussed. (Author's abstract)
W86-04070

TRANSPORT OF HALOGENATED ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW,

Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
N. J. Hutzler, J. C. Crittenden, J. L. Oravitz, C. J. Meyer, and A. S. Johnson.

In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 115-118, 5 fig, 9 ref. Contract No. R809464-01-0.

Descriptors: *Organic compounds, *Path of pollutants, *Groundwater movement, *Halogens, Modeling, Advection, Dispersion, Mass transfer, Adsorption, Equilibrium, Trichloroethylene, Groundwater.

A one-dimensional model incorporating the mechanisms of advective flow, axial dispersion, liquid-phase mass transfer, local adsorption, equilibrium, and diffusion into aggregates is developed and solved using orthogonal collocation. The model is used to simulate the breakthrough of trichloroethylene in a packed column of sandy loam soil. Parameters for the model are derived from literature correlations, the column geometry, soil adsorption isotherms, kinetics studies, and breakthrough curves. The results show that dispersion and particle aggregation play a significant role in the spreading of chemical in one-dimensional flow. (Author's abstract)
W86-04071

IMPROVED NUMERICAL MODELLING OF CONTAMINANT TRANSPORT IN SATURATED AQUIFERS,

North Carolina Univ. at Charlotte.
R. Janardhanam, and J. Frampton.

In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 122-124, 4 fig, 4 ref. Contract No. S-82-8.

Descriptors: *Modeling, *Aquifers, *Groundwater quality, *Path of pollutants, *Mathematical analysis, Saturated aquifers, Waste disposal, Groundwater pollution, Groundwater movement, Groundwater.

Contaminated discharge and run-off from landfills pose a problem to the groundwater quality. A strong need exists to evaluate the impact of present and proposed waste disposal sites on groundwater purity and the resulting effect on the public. The use of numerical models in the determination of the spread of contaminants will allow us to make advance predictions. The mathematical representation of the phenomena of mass transfer in porous media consists of two equations, a flow equation and a transport equation; the flow transport being represented by the stream function. Galerkin finite element technique is used to simulate the transport of contaminants in a two dimensional rectangular confined aquifer. The pollutant is assumed to discharge continuously from the top boundary of the aquifer. The spread of the contaminants at different

time steps are determined to calculate concentration isopleths. For a high degree of accuracy, a refined mesh near the contaminant source is recommended. (Author's abstract)
W86-04073

GROUNDWATER POLLUTION IN NORTHWEST ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
H. M. Jeffus.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 125-126, 2 fig, 1 tab.

Descriptors: *Groundwater pollution, *Remote sensing, *Wastewater disposal, *Waste disposal, Radar, Coliforms, Aerogenes, Streptococcus, Bacteria, Water pollution prevention, Groundwater, Arkansas.

Radar imagery photographs of northwest Arkansas revealed that the near surface formations are heavily fractured with the fracture traces, or linears, easily traceable on the photographs. A superimposition of the linear traces on well and spring locations reveals that the springs and most higher producing wells are on these linears. Since the linears provide an easy path for surface contaminants to enter these wells and springs, it was reasoned that most would be contaminated. An investigation of 70 wells in an area 10 miles by 10 miles revealed that 80 percent were contaminated with coliform bacteria. Enumeration of aerogenes, fecal coliform and fecal Streptococci found a range of 1 to 2,080,000 organisms per 100 milliliters. A correlation was determined between high nitrate and high phosphate with a heavier concentration of bacteria. Sources of the contaminants were determined to be septic tank leach fields, confined live stock feeding, solid waste disposal landfills and spreading of agricultural wastes on pastureland. Possibilities or corrective action are: reduced spreading of manure on fields and pastures, better design of septic tank absorption fields, on-site chlorinators for domestic water supplies and in some cases, extension of treated water supplies to rural areas. These same conditions of shallow well contamination in fractured limestone probably exists in western Arkansas, eastern Oklahoma, southern Missouri and south-east Kansas. (Author's abstract)
W86-04074

PHYSICAL TRANSPORT PROCESS FOR HYDROCARBONS IN THE SUBSURFACE,
Underground Resource Management, Inc., Austin, TX.
J. R. Kovski.
In: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, TX. (1985). p 127-128, 2 ref.

Descriptors: *Hydrocarbons, *Groundwater movement, *Path of pollutants, *Groundwater pollution, Physical properties, Viscosity, Density, Groundwater.

The transport of hydrocarbons in the subsurface is a very complex combination of physical, chemical, and biological processes. While the chemical and biological processes are very important in the longterm transport of hydrocarbons, the short-term transport of hydrocarbons is dominated by the physical process. An understanding of the physical transport process will allow more efficient recovery of the hydrocarbon, leaving less in the subsurface to be acted upon by the chemical and biological processes. This paper examines the physical process which controls the rate and extent of movement of hydrocarbons in the subsurface. The physical process of transport is dependent upon such factors as hydrocarbon viscosity, hydrocarbon density, hydrocarbon release rate, the hydrocarbon release volume, the water table depth, the groundwater gradient, water table fluctuation, subsoil grain size, and rainfall pattern. These factors are examined, and their impacts on rate and extent of hydrocarbon movement are addressed. (Author's abstract)
W86-04075

VIRAL AND BACTERIAL CONTAMINATION OF GROUNDWATER BY ON-SITE WASTEWATER TREATMENT SYSTEMS IN SANDY COASTAL SOILS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
C. L. Moe, C. G. Cogger, and M. D. Sobsey.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 132-134, 4 tab, 6 ref. Contract No. NA81AA-D-00026.

Descriptors: *Groundwater pollution, *Wastewater treatment, *Sand, *Coasts, Shore, Septic tank effluents, Septic tanks, Viruses, Coliforms, Streptococci, Wastewater, Groundwater.

Contamination of groundwater by enteric viral and bacterial pathogens is an important public health concern for on-site wastewater treatment systems, especially in highly developed and populated coastal areas with permeable soils and seasonally high water tables. Viral and bacterial contamination of groundwater by on-site wastewater treatment systems was studied in an experimental field site on the NC. coast. A low pressure dosing system applied septic tank effluent (STE) at three hydraulic loading rates to two, adjacent drainfields with the same sandy soil but different water table depths. In seasonal experiments known amounts of bovine enterovirus type 1 (BE-1) were added to the STE. Groundwater samples from the fields were analyzed for BE-1 twice weekly before, during and after virus dosing periods of three weeks. Fecal coliforms, fecal streptococci, coliphages and several chemical constituents were also measured periodically. Concentrations of BE-1, coliphages, fecal coliforms and fecal streptococci were reduced from their levels in STE in both fields; however, reductions were several log10 greater in the field with the deeper water table. BE-1 was detected in groundwater by the second day of virus dosing and persisted as long as 30 days postdosing. There was no consistent pattern of increased microbial concentrations in groundwater at greater hydraulic loading rates of STE. Seasonal experiments showed temperature and overload effects on the system. The results demonstrate the importance of unsaturated flow for efficient removal of enteric viruses and bacteria by septic systems. (Author's abstract)
W86-04077

NITRATE CONCENTRATIONS IN MUNICIPAL WELLS LOCATED WITHIN A RIVER BED,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-04078

FINITE ANALYTIC METHOD FOR SOLUTION OF ONE-DIMENSIONAL TRANSIENT TRANSPORT EQUATIONS,
Drexel Univ., Philadelphia, PA. Dept. of Civil Engineering.
B. K. Panigrahi, and J. C. Hwang.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 138-141, 7 fig, 1 tab, 5 ref.

Descriptors: *Mathematical analysis, *Transport equations, *Path of pollutants, *Finite analytic method, Solute transport, Convection, Dispersion, Groundwater.

A new numerical method called finite analytic method is proposed to solve the ground water solute transport problems. This method differs from the others in that it incorporates local analytical solutions to a numerical scheme for the linear or nonlinear partial differential equation describing the global problem. The proposed method is used to solve three cases of one-dimensional convective-dominated solute transport problems in ground water system. They are less, moderately and highly convective dominated transport problems with grid peclet number equals to 1, 10 and 100 respectively. The corresponding dispersion coefficients are 0.25, 0.025, and 0.0025 respectively. The other physical parameters considered for the solution scheme are seepage velocity of 0.5, spatial grid length of 0.5 and a time interval of 0.4. The results are compared with the exact solution, Crank-Nicholson finite difference scheme and Galerkin finite element method. The new scheme is capable of producing reliable and stable solutions. (Author's abstract)
W86-04079

DEVELOPING INFORMATION ON ALDICARB LEVELS IN LONG ISLAND GROUNDWATER,
Cornell Univ., Ithaca, NY. Center for Environmental Research.
K. S. Porter, A. T. Lemley, H. B. Hughes, and R. L. Jones.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 142-145, 3 fig, 4 tab, 10 ref.

Descriptors: *Groundwater pollution, *Aldicarb, *Chemical analysis, Groundwater, Pesticides, TEMIK, Drinking water, Wells, Degradation.

Since the discovery of aldicarb residues in Long Island groundwater in 1979, well over 10,000 soil and water samples on Long Island have been analyzed. Work reported herein couples this extensive data base with further field and laboratory studies to develop a sound scientific assessment of the expected duration and distribution of aldicarb residues in Long Island groundwater. Preliminary results from the shallow groundwater field site and monitoring wells indicate that the average concentration of aldicarb residues on Long Island is dropping. The decline of residues in areas where relatively deep groundwater is present is less apparent due to the continuing recharge of residues into groundwater from the unsaturated zone. Preliminary results from laboratory studies indicate that the half-life of aldicarb residues is approximately 2-3 years in Long Island groundwater. Laboratory studies show that estimates of half-lives obtained from distilled water hydrolysis studies using actual soil and water samples from the specific locations. (Lantz - PTT)
W86-04080

SPRINGS ARE MORE EFFICIENT AND RELIABLE THAN WELLS FOR MONITORING GROUND WATER QUALITY IN MOST LIMESTONE TERRAINS - A CONSEQUENCE OF TRANSPORT PROCESSES OCCURRING IN CONDUITS,
National Park Service, Mammoth Cave, KY.
J. F. Quinlan, and R. O. Ewers.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 146-148, 2 fig, 9 ref.

Descriptors: *Groundwater quality, *Wells, *Springs, *Monitoring, *Groundwater management, Water quality, Water pollution control, Groundwater movement, Infiltration, Groundwater.

In mature karst areas, where carbonate bedrock is above the water table, infiltration water percolates vertically until it intercepts a cave system in which most flow is: (1) nearly horizontal, (2) in conduits, (3) convergent, generally dendritic or trellised, (4) generally in the uppermost fringe of the phreatic zone, and (5) to a spring (or group of springs) that drains an entire groundwater basin. The flow in a large conduit is in many ways analagous to flow in a surface river. The trunk flow of both is fed by tributaries and by diffuse flow through the surrounding rock or sediment; but most of the flow to a conduit is at a higher velocity than it is to a surface river, and it is through vertical joints and bedding planes rather than pores. The only sure way to sense the active flow from a site to be monitored is to intercept the conduit system that

drains it. And unless one can prove (generally by dye-tracing) that a particular cave stream drains all of the site, springs, rather than observation wells, are the most efficient, reliable, and economical places to monitor for pollutants in most limestone terrains where carbonate rock is in the vadose zone. This is because the probability of a randomly located drill hole intersecting such a conduit is almost nil. A plan to guarantee sensing of the conduit system should include: (1) location of springs along streams and in sinkhole bottoms, (2) dye-tracing to show the presence or absence of flow routes, and (3) judicious selection of springs as leachate-monitoring and background-monitoring sites, as discussed in the text. The plan may include monitoring of cave streams and mapping of the potentiometric surface and of groundwater basin boundaries. (Author's abstract)
W86-04081

EFFECT OF STOCHASTIC INPUTS AND PARAMETERS IN SOLUE-TRANSPORT MODELING,
Oklahoma State Univ., Stillwater.
J. Wagner, W. Pettyjohn, K. Goff, B. Huffman, and D. Saunders.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 149-154, 8 fig, 44 ref. Contract No. CR-811116.

Descriptors: *Aquifers, *Water quality modeling, *Modeling, *Stochastic hydrology, *Path of pollutants, *Groundwater pollution, *Solute transport, Parametric hydrology, Monte Carlo Method, Mathematical studies, Statistical analysis, Groundwater, Pollutants.

Successful planning, design and regulatory evaluations should be based on both deterministic and stochastic techniques, but most scientists and engineers treat solute-transport calculating as if they were only deterministic. In conventional solute-transport predictions, random variables and uncertain model parameters are replaced by their expected values and the resulting deterministic model is solved. An approach of this type can often be misleading. With stochastic analysis, it becomes possible to make statements such as: At the point of interest, the concentration interval of 5.0 to 10.0 mg/l includes the expected value with a probability of 0.95. The use of Monte-Carlo methods to introduce stochastic variables into a deterministic analytical solute-transport model is demonstrated. This approach can account for uncertainties in boundary conditions, such as input flow rates and concentrations, as well as uncertainties in model transport coefficients, such as hydraulic conductivity and hydrodynamic dispersion coefficients. The results of this stochastic modeling approach include not only the expected value of concentration at a point of interest, but also the frequency distribution for the concentration based on uncertainties in the model input and transport parameters. The frequency distribution can be used to assess the risk posed by the release a chemical substance into the subsurface environment. Information gained by a stochastic analysis can also be used to decide whether parameters on a deterministic model have been evaluated with sufficient precision for use in a simulation. Finally, the introduction of randomness or uncertainty into a model must reflect what is physically happening in the process to the extent possible. (Author's abstract)
W86-04082

SEAWATER INTRUSION IN THE SAN JUAN ISLANDS,
San Diego State Univ., CA. Dept. of Natural Science.
W. J. Wallace.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 155-157, 5 fig, 19 ref.

Descriptors: *Saline water intrusion, *Groundwater pollution, *Washington, *Wells, Encroachment, Monitoring, Spectral analysis, San Juan Islands.

A study of seawater intrusion into the groundwater of three islands in San Juan County, Washington was done throughout 1980, with subsequent monitoring through summers including 1983. The indigenous human population depends solely upon groundwater. Subsequently, hundreds of wells have been drilled which eliminated the problem of new drilling to provide water study samples. Fifty-one in and out of use wells provided the sample base which were monitored monthly for possible seawater intrusion using the chloride ion concentration as an indicator. Atomic absorption was used when more detailed analyses were necessary. Data from neighboring individual wells showing seawater intrusion were used to develop a general horizontal picture of seawater intrusion patterns. A few of the conclusion thus far are: (1) A deep well which has been drilled into fractured rock shows less variance in water composition with time. Wells drilled deep into gravels, however, show considerably more variation; (2) If a well water is to be analyzed only annually as a check against possible sea water intrusion then late fall is the best time, since water use is high, precipitation low, and the water table is lowered; (3) Physical monitoring of a well's dynamic water level is not in itself a means to be solely trusted to identify sea water intrusion since it does not always rise and fall with the tide; (4) The Ghyben-Herzberg relation which assumes simple hydrostatic conditions in a homogeneous, unconfined coastal aquifer does not describe the sea water/fresh water lens in the San Juan area studied; and (5) From the year's analytical data horizontal maps delineating areas of sea water intrusion can be drawn. Vertical profile diagrams present significantly greater problems. (Lantz - PTT)
W86-04083

SUBSURFACE TRANSPORT OF URBAN RUNOFF POLLUTANTS,
Arizona Univ., Tucson.
L. G. Wilson, C. P. Gerba, M. W. Bolton, and J. B. Rose.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 158-160, 4 fig, 2 tab, 3 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Urban runoff, *Vadose water, *Runoff pollution, Gravity groundwater, Groundwater pollution, Water pollution, Metals, Microorganisms, Organic matter, Tucson, Arizona, Water sampling.

Five injection tests were conducted on an experimental dry well at a site near Tucson, Arizona. Primary goals of the tests were to determine flow patterns in the vadose zone, and attenuation of urban runoff pollution (metal, microorganisms, and organic matter) in vadose zone/groundwater flow systems. A perched groundwater system and a water table mound were observed by neutron moisture logging with lateral flow velocities averaging 500 ft/day. Metals were detected breaking through in a vadose zone sampling well. Microbial tracers were also observed in the vadose zone sampling wells, but peak values were markedly reduced below input values. The initial concentration of organic matter breaking through in the sampling well was 58% of the input values. No organic matter of microorganisms were detected in pumped groundwater samples. It was generally concluded that (1) dry well injection of urban runoff may develop perched groundwater systems capable of spreading injected water within the radius of influence of nearby wells, and (2) given the pollutant loading rates of the test, groundwater was not deteriorated. (Author's abstract)
W86-04084

FINITE ELEMENT METHOD WITH REGION WISE ITERATION SCHEME FOR SOLVING GROUNDWATER SOLUTE TRANSPORT EQUATION,
Oak Ridge National Lab., TN.
G. -T. Yeh, and J. C. Hwang.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 161-164, 5 fig, 10 ref.

Descriptors: *Mathematical analysis, *Finite element method, *Path of pollutants, *Groundwater movement, *Groundwater pollution, Computer programs, Groundwater, Galerkin Finite Element Method.

By using subregion iteration with the orthogonal weighting finite element method for computating large-field problems of groundwater solute transport, CPU memory requirement can be drastically reduced. The convergence rate is enhanced over the pointwise iteration method. The use of orthogonal weighting functions assures convergence because the resulting coefficient matrix is always irreducible and diagonally dominant. Such properties of a matrix are closely tied to the sufficient conditions for the convergence of an iteration method. Computer runs for test problems were carried out for 10 x 10, 30 x 30 and 50 x 50 grid systems with 2,3 and 4 subregions. The CPU memory and CPU time were monitored during each run. The numbers of iterations required for convergence in each time step were also recorded. The results are useful information for the determination of the number of subregions required for a given computer memory capacity and for the estimation of the CPU time using the subregion iteration method. (Author's abstract)
W86-04085

SOME CONCEPTS PERTAINING TO INVESTIGATIVE METHODOLOGY FOR SUBSURFACE PROCESS RESEARCH,
Robert S. Kerr Environmental Research Lab., Ada, OK.
W. J. Dunlap.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 167-172, 5 fig, 7 ref.

Descriptors: *Groundwater movement, *Path of pollutants, *Groundwater pollution, *Soil columns, Core drilling, Aquifers, Groundwater, Microcosm systems, Subsurface water, Investigative methodology.

Problems of investigative methodology comprise a critical and often preponderant element of research to delineate and quantitate processes which govern the transport and fate of pollutants in subsurface environments. Examination of several recent research studies illustrates that both laboratory and field (in-situ) methodologies are useful in subsurface processes research, but also clearly shows that such research involves formidable methodological problems which result primarily from the nature of terrestrial subsurface environments. Such environments are usually remote and relatively inaccessible. This causes major methodological problems in acquiring authentic, uncontaminated samples of water and/or solids for analysis and microcosm construction. Subsurface environments are also highly structured and often exhibit significant heterogeneity across relatively short distances, which causes difficulties in determining proper locations for sample acquisitions and in simulating subsurface environments in the laboratory. Finally, slow rates of movement and long residence times of water and pollutants within subsurface environments are responsible for methodological problems associated with the need to detect and characterize processes occurring at very slow rates. Advances in a number of diverse areas, including particularly geophysical methods, analytical procedures, microcosm technology, and drilling, coring, and well completion techniques, are required for needed improvements in methodology for subsurface processes research. (Author's abstract)
W86-04086

STATISTICAL EXAMINATION OF SMALL-SCALE SPATIAL VARIABILITY OF VOLATILE ORGANIC COMPOUNDS AND INORGANIC ANIONS IN GROUNDWATER,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. E. Barbash, and J. F. Barker.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston,

Texas. (1985). p 177-180, 6 fig, 2 tab, 11 ref.

Descriptors: *Statistical analysis, *Organic compounds, *Inorganic compounds, *Groundwater pollution, Spatial distribution, Groundwater movement, Volatile organic compounds, Landfills, Aquifers, Groundwater.

One approach to the study of processes governing the fate of chemical contaminants in groundwater is the detailed examination of previously contaminated systems. A chi-square analysis of the distributions of nine volatile organic compounds (VOCs) and three inorganic anions in the groundwater in unconsolidated sediments beneath an abandoned landfill near Ottawa, Ontario indicates that the small-scale (1 m) spatial variability of contaminant concentrations is significantly higher for VOCs than for inorganic species. While concentration versus-depth profiles for inorganics are relatively 'smooth,' corresponding VOC profiles are highly irregular, with concentrations in points spaced one meter apart often differing by one to four orders of magnitude. Differences in spatial heterogeneity between three VOCs and the inorganic species were statistically significant close to the inferred source area, but non-significant in wells further down-gradient. The description of the spatial distribution of contaminants in unconsolidated aquifers may therefore require a much higher density of sampling points for VOCs than for inorganic species. (Author's abstract)
W86-04089

IN-SITU DETERMINATION OF DISPERSION COEFFICIENTS AND ADSORPTION PARAMETERS FOR CONTAMINANTS USING A PUSH-PULL TEST,
Insitu Consulting, Laramie, WY.
A. C. Bumb, I. J. Drever, and C. R. McKee.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 186-190, 6 fig, 19 ref.

Descriptors: *In-situ tests, *Groundwater movement, *Mathematical analysis, *Path of pollutants, Dispersion, Adsorption, Aquifers, Groundwater pollution.

This paper describes a practical in-situ test procedure for measuring dispersion coefficients and adsorption parameters. The procedure involves injection of a relatively small volume of groundwater spiked with the solute of interest and subsequent production of fluid. Laboratory experiments are required to define the form of the adsorption equation, and to determine the volume and concentrations to be injected. The dispersion coefficient is determined by history matching the effluent composition of a non-adsorbing species, for which total anions is an alternative, against the computer results. The adsorption parameters are then determined by history-matching the effluent composition against the computer results. A computer program has been developed which uses any one of several adsorption equations. A boundary condition used in previous studies is shown to be in error, and the current boundary condition is presented. (Author's abstract)
W86-04092

SIMPLIFIED GROUNDWATER SAMPLING TECHNIQUES AT LANDFILLS,
Beling Consultants, Inc., Moline, IL.
R. L. Schaffer, and J. F. Merchie.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 208-209.

Descriptors: *Groundwater, *Water sampling, *Landfills, *Water analysis, Groundwater pollution, Monitoring, Wells, Statistical analysis, Sampling.

The Department of Water, Air and Waste Management (WAWM) for the State of Iowa established protocol for groundwater sample collection at landfills. A 'non-protocol' collection technique was used at the Clinton County Area Solid Waste Agency (CCASWA), East Landfill Site, in Clinton, Iowa, to reduce labor costs. When three (3) successive semi-annual sample analyses exceeded the lead concentration standard at a single monitoring well for the municipal landfill, WAWM requested a comprehensive and costly site investigation. Subsequently, a reduced scope of investigation was negotiated between WAWM and CCASWA. WAWM agreed that, if the reduced scope investigation could prove (1) that non-protocol sampling was environmentally conservative, and (2) there was no tendency for increased lead concentration with respect to time, then the CCASWA could continue non-protocol sampling, so long as groundwater contamination levels were below the threshhold limits. A statistical analysis of the difference between the collection techniques indicated the non-protocol technique is environmentally conservative compared to the protocol collection technique, with a 90% degree of confidence. Regression analysis of the laboratory tests of non-protocol-collected samples indicated there was no tendency for increased lead concentration with time. (Author's abstract)
W86-04098

INDICES IDENTIFYING SUBSURFACE MICROBIAL COMMUNITIES THAT ARE ADAPTED TO ORGANIC POLLUTION,
Florida State Univ., Tallahassee. Center for Biomedical and Toxicological Research.
G. A. Smith, J. S. Nickels, J. D. Davis, R. H. Findlay, and P. S. Vashio.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 210-213, 1 fig, 3 tab, 19 ref.

Descriptors: *Subsurface water, *Organic compounds, *Groundwater pollution, *Microbiological studies, *Microenvironment, Groundwater, Water analysis, Biological analysis.

The subsurface microbiota and their extracellular excretion products are of primary importance in the maintenance of the ground water resources particularly when the water is polluted. With the development of quantitative biochemical assays for biomass, community structure, and metabolic activities of the microbes of the subsurface sediments, it proved possible to search for assays that correlated with exposure to pollution. The subsurface sediments from an abandoned creosote waste deposit showed that exposure to pollution increased the total microbial biomass as measured by the extractable phospholipid; shifted the community structure by decreasing the proportion of gram positive bacteria that form glycerol teichoic acids and induced distinctive changes in the ester-linked phospholipid fatty acids. Pollution of the subsurface sediments caused a shift in the nutritional status to a more balanced growth condition in the unsaturated zone reflected in an increased rate of phospholipid formation relative to the formation of the endogenous storage polymer beta hydroxyalkanoate measured after a short exposure to 14C-acetate. In the saturated zone, contamination induced unbalanced growth. (Author's abstract)
W86-04099

MODELS FOR POLLUTED STREAMS SUBJECT TO FAST PURIFICATION,
Roorkee Univ. (India). Dept. of Civil Engineering.
D. S. Bhargava.
Water Research WATRAG, Vol. 20, No. 1, p 1-8, January 1986. 2 fig, 4 ref.

Descriptors: *Model studies, *Mathematical models, *Water pollution, *Organic compounds, Assimilative capacity, Wastewater, Self-purification, Biological oxygen demand, Dissolved oxygen, Wastewater outfalls, Rivers.

The classic Streeter-Phelps models for stream analysis, though in use for the last five decades, are of little value for an accurate prediction of polluted streams' BOD and DO sag parameters, because they do not account for bioflocculation taking place after the sewage outfalls into streams as a result of which, settleable BOD, a significant component of the total BOD, is removed in short distances. The extremely fast BOD assimilation in rivers Ganga and Yamuna of the Indeogangetic plain modelled for the physico-chemical linear removal of the settleable BOD and exponential decay of the nonsettleable BOD, has been utilized for evolving models for accurate prediction of DO sag parameters and BOD in point and nonpoint systems of waste outfalls. Case examples have been presented for illustrating the computation of compound DO sag resulting from multi-waste outfalls, and to show the superiority of a point system over the nonpoint system of waste disposal. (Lantz-PTT)
W86-04101

COMPARISON OF TWO RIVER QUALITY MODELS,
Birmingham Univ. (England). Dept. of Civil Engineering.
R. W. Crabtree, I. D. Cluckie, C. F. Forster, and C. P. Crockett.
Water Research WATRAG, Vol. 20, No. 1, p 53-61, January 1986. 4 fig, 6 tab, 18 ref, 1 append.

Descriptors: *Model studies, *Rivers, *Water quality, Comparison studies, Modelling, Blackwater model, Thames Water Authority, England.

Two deterministic river quality models are evaluated and compared by applying them to the R. Blackwater. The first model, Qual-II is a general purpose universal model developed by the United States Environment Protection Agency and the second a version of the Water Research Centre river quality model (Blackwater model) developed specifically for the R. Blackwater by Thames Water Authority but is no longer in use. After model calibration, the general Qual-II model produced a closer prediction than the Blackwater model, when compared with observed data. The main reason for the differences in the model results was considered to be the treatment of non-point input sources. The results suggest that if modelling resources are limited, the Qual-II model can be applied rather than a river specific model. (Author's Abstract)
W86-04108

NITROGEN-ISOTOPE STUDY OF THE SOURCE OF NITRATE CONTAMINATION IN GROUNDWATER OF THE PLEISTOCENE COASTAL PLAIN AQUIFER, ISRAEL,
Weizmann Inst. of Science, Rehovoth (Israel). Dept. of Isotope Research.
N. Kaplan, and M. Magaritz.
Water Research WATRAG, Vol. 20, No. 2, p 131-135, February 1986. 1 fig, 3 tab, 24 ref.

Descriptors: *Groundwater pollution, *Fertilizers, *Nitrates, *Isotope studies, Nitrogen isotope, Coastal aquifers, Israel, Radioisotopes, Wastewater irrigation.

An elevated level of NO3(-) (mean value for 1981 was 53 mg/l NO3(-) as NO3(-)) occurs in phreatic groundwater in the Coastal Plain sandy aquifer, Israel. NO3(-) in water with a wide range of concentrations has delta 15N in the range of +4.7 to +11.4 parts per thousand, suggesting derivation from oxidation of soil organic matter and (in specific cases) from animal wastes. Only one sample has delta 15N=-0.3 parts per thousand that would indicate derivation through fertilizer application. Water from sewage treatment plant used for irrigation, or for filtration into the aquifer, is highly enriched in 15N (+19.2 to +28.8 parts per thousand), reflecting ammonia volatilization. The isotopic data are consistent with the models previously published, which suggest that the main sources of NO3(-) contamination in groundwater in the region are: oxidation of organic matter during cultivation of virgin land and swamp reclamation. (Author's abstract)
W86-04119

COMPARISON OF POSITIVELY CHARGED MEMBRANE FILTERS AND THEIR USE IN CONCENTRATING BACTERIOPHAGES IN WATER,

Florida Univ., Gainesville. Dept. of Microbiology and Cell Science.
For primary bibliographic entry see Field 5A.
W86-04121

STATIC SHAKE-FLASK BIOTRANSFORMATION OF ENDOTHALL,
North Texas State Univ., Denton. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5C.
W86-04132

BEHAVIOR OF METHYLTIN COMPOUNDS UNDER SIMULATED ESTUARINE CONDITIONS,
New Hampshire Univ., Durham. Dept. of Chemistry.
O. F. X. Donard, and J. H. Weber.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1104-1110 November 1985. 3 fig, 2 tab, 24 ref.

Descriptors: *Fate of pollutants, *Estuaries, *Simulation analysis, *Metal organic pesticides, *Model studies, *Methyltin compounds, Tin, Pollutant identification, Industrial wastes, Models, Heavy metals, Fulvic acids, Separation techniques.

A 2 to the third power factorial design is used to study the behavior of MeSnCl3, Me2SnCl2, and Me3SnCl under laboratory-simulated estuarine conditions. The quaternary system includes methyltin ions (5 mg/liter as Sn), ionic strength (0-35 g of NaCl/liter) fulvic acid (0-25 milligrams/ liter), and hydrous iron oxides (0-1000 milligrams/liter). Analysis of methyltin compounds involves hydride generation, separation by chromatographic packing material, atomization in a heated quartz furnace, and detection by atomic absorption spectroscopy. Removal of organotin compounds from solution after filtration at 0.4 micrometers is from 83 to 100% for MeSnCl3, from 28 to 66% for Me2SnCl2, and from 15 to 28% for Me3SnCl. Increasing ionic strength inhibits the removal of MeSnCl3 and Me2SnCl2. Fulvic acid concentration contributes to increased removal of organotin compounds in saline waters but prevents adsorption of Me2SnCl2 under freshwater-simulated conditions. Higher iron oxide concentration enhances removal of MeSnCl3 and Me2SnCl2 but has little effect on Me3SnCl. This discusses mechanisms involved and relates them to estuarine processes. (Author's abstract)
W86-04133

SEASONAL VARIATION IN WEATHERING AND TOXICITY OF CRUDE OIL ON SEA-WATER UNDER ARCTIC CONDITIONS,
Tromsoe Univ. (Norway). Dept. of Chemistry.
L. K. Sydnes, T. H. Hemmingsen, S. Skare, S. H. Hansen, and I. B. Falk-Petersen.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1076-1081 November 1985. Project Nos. 312, 406, and 505.

Descriptors: *Toxicity, *Oil, *Seawater, *Arctic, *Weathering, Degradation, Diatoms, Echinoderms, Marine animals, Marine plants, Arctic zone, Oil spills, Oil pollution, Oxidation, decomposition, Fate of pollutants, Seasonal variation, Skeletonema costatum, Strongylocentrotus droebachiensis, Strongylocentrotus droebachiensis.

Laboratory experiments were carried out to assess how the natural variation in solar energy influx in an arctic area would affect the formation of photoproducts with respect to oxygen content, water solubility, and toxicity. Experiments, lasting for 14 days, were carried out each month from February 1983 to January 1984. Studies on the weathering of Ekofisk crude oil in seawater showed that the oil composition is affected mainly by evaporation during October to February. During the rest of the year the composition is considerably influenced by photoxidation and subsequent dissolution of polar oxidation products in the water phase. The phototoxicity of the seawater samples to the marine diatom Skeletonema costatum was tested immediately after weathering. The toxicity of the seawater samples was evaluated in sea urchin eggs from Strongylocentrotus droebachiensis and S. pallidus. Results of the biological tests clearly show that the toxicity of the water-soluble oil fraction depends on the conditions persisting during the weathering period. Polar oxidation products present in the water phase are toxic and may represent a hazard to marine organisms in the Arctic spring and summer. (Geiger - PTT)
W86-04134

SCAVENGING OF AIRBORNE POLYCYCLIC AROMATIC HYDROCARBONS BY RAIN,
Ministerie van Volksgezondheid en Milieuhygiene, Leidschendam (Netherlands). Lab. for Ecology, Water and Drinking Water.
P. C. M. van Noort, and E. Wondergem.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1044-1048 November 1985. 2 fig, 6 tab, 16 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Air pollution, *Acid precipitation, *Fate of pollutants, *Chemistry of precipitation, Precipitation, Rain, Organic compounds.

The variation of the concentrations of some polycyclic aromatic hydrocarbons in rain with time during three precipitation events was determined. On all occasions these concentrations were found to decrease during the precipitation events. The apparent removal rate constants on a precipitation amount base for two of the three events were calculated to be 1.46 and ca. 3/mm. For the third event the concentration decrease did not allow the calculation of the apparent removal rate constant. Furthermore, concentrations of polycyclic aromatic hydrocarbons in rain sampled simultaneously at ground level and at an altitude of 200 m were determined. These measurements demonstrate that concentrations of phenanthrene and fluoranthene in rainwater at ground level are noticeably higher than those at 200 m. No significant differences in concentrations of benzo(k)fluoranthene, benzo(b)fluoranthene, benzo(a)pyrene, dibenz(a,h) anthracene, benzo(ghi)-perylene, and indeno(1,2,3-cd)pyrene in rain at the two altitude were found. It is concluded on the basis of these findings that at least on the event, with sampling at two altitudes, the main process responsible for the presence of phenanthrene in rain is below-cloud gas-phase scavenging and that for the other compounds except fluoranthene and benz(a)anthracene it holds that in-cloud scavenging is the main process; for fluoranthene and benz(a)anthracene below-cloud gas-phase scavenging and in-cloud scavenging are about equally important. (Author's abstract)
W86-04135

ORGANIC EMISSIONS FROM SHALE OIL WASTEWATERS AND THEIR IMPLICATIONS FOR AIR QUALITY,
Colorado Univ. at Boulder. Dept. of Chemistry.
S. B. Hawthorne, R. E. Sievers, and R. M. Barkley.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 992-997, October 1985. 4 tab, 29 ref.

Descriptors: *Organic compounds, *Oil shale, *Industrial wastewater, *Air pollution, *Fate of pollutants, Organic wastes, Shales, Wastewater, Phenols, Aromatic compounds, Hydrocarbons, Path of Pollutants, Henry's Law.

The emission of organic compounds from shale oil wastewaters used to cool hot, retorted, spent oil shale and for codisposal with retorted shale was investigated. The major classes of compounds emitted are aromatic nitrogen-containing compounds, ketones, phenols, and nitriles, the same as those previously reported to be emitted from wastewaters exposed to air at room temperature. A gas-stripping method was modified to allow the determination of several Henry's law constants (H) simultaneously. Measured values of H for these solutes in the wastewaters (.0001-.00001 atm cu m/mol) generally agreed with values determined for solutes in pure water, indicating that the wastewater matrix has little effect on H. Air samples collected in regions likely to be affected by atmospheric emissions from the shale oil industry had no detectable levels of the major organic species that are emitted from shale oil wastewaters, indicating that these species may be useful in tracing pollutant air masses resulting from shale oil production. (Author's abstract)
W86-04138

MICROBIAL TRANSFORMATIONS OF SUBSTITUTED BENZENES DURING INFILTRATION OF RIVER WATER TO GROUNDWATER: LABORATORY COLUMN STUDIES,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
E. P. Kuhn, P. J. Colberg, J. L. Schoor, O. Wanner, and A. J. B. Zehnder.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 961-968, October 1985. 7 fig, 27 ref.

Descriptors: *Biotransformation, *Microbial degradation, *Fate of pollutants, *Benzenes, *Infiltration, Biodegradation, Organic compounds, Hydrocarbons, Path of pollutants, Groundwater pollution, Aquifers, Anaerobic conditions, Groundwater movement, Aerobic conditions, Simulation analysis.

The microbial transformations of dimethyl- and dichlorobenzenes have been studied in laboratory aquifer columns simulating saturated-flow conditions typical for a river water/groundwater infiltration system. The behavior of all compounds in the laboratory was qualitatively the same as that observed at a field site. Both dimethyl- and dichlorobenzes were biotransformed under aerobic conditions, the dimethylbenzenes faster than the chlorinated analogues. Evidence is presented that dimethyl-benzenes are degraded by denitrifying bacteria under anaerobic conditions. Dichlorobenzenes were not transformed under these conditions. Significant differences in the rate of transformation between isomers were found. The dimethylbenzenes and p-dichlorobenzene appeared to be utilized by bacteria as sole carbon and energy sources. Transfer of rate constants determined in the laboratory at elevated substrate concentrations to the field was difficult. (Author's abstract)
W86-04139

CLIMATOLOGICAL VARIABILITY,
Argonne National Lab., IL.
D. G. Streets, B. M. Lesht, J. D. Shannon, and T. D. Veselka.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 887-983, October 1985. 2 fig, 4 tab, 13 ref.

Descriptors: *Model studies, *Climatic data, *Acid rain, *Sulfur, *Fate of pollutants, Sulfate, Models, Path of pollutants, Air pollution, Climatology, Deposition, Meteorological data collections, Cost analysis, Sulfur dioxide.

This articles examines how a control strategy for acid deposition might vary when optimized under different assumptions about future meteorological conditions. The Advanced Statistical Trajectory Regional Air Pollution (ASTRAP) model was used to simulate long-term deposition of sulfur oxides in the United States from 1976 to 1981. To calculate source-receptor matrices, electric utility emissions within each state were mapped in a horizontal grid on the same spatial scale as precipitation. The deposition (wet, dry, and total) of total sulfur dioxide (sulfur dioxide plus sulfate) as equivalent sulfate was computed for nine sensitive receptor regions. Source-receptor matrices were determined for each annual period and for an average data set covering the 6-yr period. Wet deposition and total deposition matrices were constructed, making 14 matrices in all. Results showed that wet deposition is more variable than dry deposition and that receptor areas remote from major source regions show more variation than receptor areas near source regions. The higher the deposition reduction required, the greater the susceptibility of the optimum strategy to climatological variation. Strategies designed to achieve an absolute level of wet deposition are considerably more sensitive to

meteorological variability than those designed to achieve a specified percentage of reduction in wet deposition. (Geiger - PTT)
W86-04140

MIGRATION OF WOOD-PRESERVING CHEMICALS IN CONTAMINATED GROUNDWATER IN A SAND AQUIFER AT PENSACOLA, FLORIDA,
Geological Survey, Menlo Park, CA.
D. F. Goerlitz, D. E. Troutman, E. M. Godsy, and B. J. Franks.
Environmental Science and Technology ESTHAG, Vol. 19, No. 10, p 955-961, October 1985. 4 fig, 8 tab, 10 ref.

Descriptors: *Phenols, *Creosote, *Groundwater pollution, *Sand aquifers, *Fate of pollutants, *Pensacola, *Florida, Industrial wastes, Path of pollutants, Biotransformation, Sorption, Aquifers, Organic compounds, Industrial wastewater, Biodegradation, Pentachlorophenol, Reservoirs, Naphtalene.

Operation of a wood-preserving facility for nearly 80 yr at Pensacola, Florida, contaminated the near-surface groundwater with creosote and pentachlorophenol (PCP). The major source of aquifer contamination was unlined surface impoundments that were in direct hydraulic contact with the groundwater. Episodes of overtopping the impoundments and overland flow of treatment liquor and waste were also significant to the migration and contamination of the groundwater. Solutes contaminating the groundwater are mainly naphthalene and substituted phenols. Sorption did not influence retardation of solutes in transport in the groundwater. Phenol and the mono substituted methyl-phenols appear to be undergoing biotransformation. PCP was not found in significant concentrations in the groundwater possibly because the solubility of PCP is approximately 5 milligrams/liter at pH 6, near the average acidity for the groundwater. (Author's abstract)
W86-04141

NUMERICAL MODELING OF IMMISCIBLE ORGANIC TRANSPORT AT THE HYDE PARK LANDFILL,
Waterloo Univ. (Ontario). Dept. of Civil Engineering.
M. Osborne, and J. Sykes.
Water Resources Research WRERAO, Vol. 22, No. 1, p 25-33, January 1986.

Descriptors: *Numerical analysis, *Model studies, *Hyde Park Landfill, *Groundwater movement, Path of pollutants, Mathmatical models, Darcys Law, Simulation analysis, Niagara Falls, New York, Chemical wastes.

A two-dimensional two-phase mathematical model based on Darcy's law and conservation of mass for each liquid is presented. The numerical model is based on a generalized method of weighted residuals in conjunction with the finite element method and linear quadrilateral isoparametric elements. To alleviate numerical problems associated with hyperbolic equations, upstream weighting of the spatial terms in the model have been incorporated. The theoretical and numerical accuracy of the model is verified by comparison of simulation results with those from an existing one-dimensional two-phase flow simulator. The finite element model is used to simulate the migration of an immiscible organic solvent in groundwater, from a chemical waste disposal site located north of Niagara Falls, New York. The effects of uncertainty regarding porous media heterogeneities and anisotropy are examined, and it is concluded that the extent of immiscible contaminant migration is greatly sensitive to these parameters (Author's abstract)
W86-04158

POROUS FLOW MODEL FOR STEADY STATE TRANSPORT OF RADIUM IN GROUNDWATER,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Mineral Physics.
M. R. Davidson, and B. L. Dickson.
Water Resources Research WRERAO, Vol. 22, No. 1, p 34-44, January 1986. 5 fig, 1 tab, 43 ref, 1 append.

Descriptors: *Porous flow model, *Steady state transport, *Radium, *Groundwater movement, Groundwater pollution, Uranium, Thorium, Aquifers, Flow pattern, Adsorption.

The quasi-steady variation of uranium and radium isotopes from the decay of 238-U, 235-U, and 232-Th has been determined along an idealized, one-dimensional aquifer which is a distributed source of activity and from which the transfer of radionuclides to solution occurs by alpha recoil and chemical exchange. The model includes the effects of dispersive flow and retardation by adsorption. The importance of these effects on the variation of U and Ra activity ratios along the model aquifer is shown. Predicted limiting activity ratios (for large flow times) of 226-Ra/223-Ra, 224-Ra/228-Ra, and 226-Ra/228-Ra are 21.4, 1.5, and (approximately 1.7-2.0) (U/Th sub s), respectively (where U/Th sub s) is the activity ratio 238-U/232-Th in the aquifer rocks), although in many cases, an aquifer may not be long enough for the ratios involving 226-Ra to achieve their limiting values. (Author's abstract)
W86-04159

ORIGIN AND DISTRIBUTION OF SULFATE IN A FRACTURED TILL IN SOUTHERN ALBERTA, CANADA,
Department of Agriculture, Lethbridge (Alberta). Groundwater Section.
For primary bibliographic entry see Field 2K.
W86-04160

RIVER LOADS UNDERESTIMATED BY RATING CURVES,
Stirling Univ. (Scotland). Dept. of Environmental Science.
R. I. Ferguson.
Water Resources Research WRERAO, Vol. 22, No. 1, p 74-76, January 1986. 3 fig, 8 ref.

Descriptors: *River loads, *Rating curves, *Statistical analysis, Sediment load, Solute load, Pollution load, Least squares method, Simulation analysis, Mathematical studies.

Statistical considerations show that the sediment, solute, or pollutant load of a river is likely to be underestimated by methods in which unmeasured concentrations are estimated from discharge using a least squares regression for the logarithm of concentration. The degree of underestimation increases with the degree of scatter about the rating curve and can reach 50%. A simple correction factor, of 2.65 sq s, is proposed and tested successfully on simulated and real data sets. (Author's abstract)
W86-04162

FUNDAMENTAL PROBLEMS IN THE STOCHASTIC CONVECTION-DISPERSION MODEL OF SOLUTE TRANSPORT IN AQUIFERS AND FIELD SOILS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
G. Sposito, W. A. Jury, and V. K. Gupta.
Water Resources Research WRERAO, Vol. 22, No. 1, p 77-88, January 1986. 78 ref. NSF Grant Nos. CEE-79-20778-03 and CEE-79-8004499.

Descriptors: *Stochastic Hydrology, *Convection, *Solute transport, *Aquifers, *Soils, Convection-dispersion equation, Groundwater movement, Mathematical studies, Field tests, Path of pollutants.

The stochastic convection-dispersion equation (CDE) and its application to field scale subsurface solute transport are investigated with respect to their physical and mathematical foundations. It is shown that even the best-developed stochastic CDE models involve physical approximations and mathematical assumptions which stand in need of much more rigorous theoretical study and detailed field experimentation. The stochastic convection-dispersion model does not yet resolve clearly the mathematical conditions necessary in order to relate the mean solute concentration calculated with a field scale stochastic CDE to measured values of the solute concentration calculated with a field experiment. The 'scale effect' in respect to solute dispersion coefficients has been studied only under conditions in which results of little predictive value can be obtained. Without the clarification of these and other fundamental issues raised in the present paper, it seems prudent to conclude that additional theoretical research on field scale solute dispersion is needed and that the stochastic convection-dispersion model does not yet warrant unqualified use as a quantitative predictive tool in the management of solute movement in aquifers and field soils. (Author's abstract)
W86-04163

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 1. ESTIMATION TECHNIQUES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04168

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 2. VERIFICATION AND APPLICATIONS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04169

SOLUTE DISPERSION IN MULTIDIMENSIONAL PERIODIC SATURATED POROUS MEDIA,
Mississippi Univ., University. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2K.
W86-04170

STOCHASTIC MODELING OF THE SPACE-TIME STRUCTURE OF ATMOSPHERIC CHEMICAL DEPOSITION,
Washington Univ., Seattle. Geophysics Program.
G. D. Egbert, and D. P. Lettenmaier.
Water Resources Research WRERAO, Vol. 22, No. 2, p 165-179, February 1986. 11 fig, 2 tab, 18 ref, 1 append.

Descriptors: *Acid rain, *Stochastic hydrology, *Model studies, *Air pollution, *Rainfall, *Chemistry of precipitation, *Time series analysis, Stochastic models, Isotropy, Anisotropy, Hydrogen ion concentration, Sulfates, Spatial distribution.

A multivariate space-time stochastic model suitable for the analysis of weekly atmospheric chemistry wet deposition measurements is described. The model is heirarchical, with weekly ion concentration fields represented as the sum of a persistent long-term mean field, and yearly and weekly variation fields. A simple method of moments estimation scheme is proposed which exploits the heirarchical nature of the model to separate spatial structure at weekly, yearly, and persistent time scales. Estimation of both isotropic and anisotropic covariance functions are considered. The model was applied to precipitation, sulfate concentration, and pH measurements made in the Northeastern United States during 1980-1981. While significant spatial correlation was found at weekly and longer (long-term mean) time scales, there was little or no temporal correlation. The observed spatial correlation was substantially anisotropic, particularly for precipitation and sulfate concentration fields. The anisotropy, as well as correlation length scales, showed strong seasonal variations. Substantial differences were apparent in the spatial structure of pH and sulfate, with sulfate more closely linked to precipitation. An application of a multivariate version of the model showed that the spatial structure of the sulfate fields is not due solely to the spatial

structure of the precipitation fields. (Author's abstract)
W86-04171

TRANSFER FUNCTION MODEL OF SOLUTE TRANSPORT THROUGH SOIL: 1. FUNDAMENTAL CONCEPTS,
California Univ., Riverside. Dept. of Soil and Environmental Sciences.
For primary bibliographic entry see Field 2G.
W86-04177

INVESTIGATIONS ABOUT THE FATE OF HEAVY METALS IN LAKES: 1. THE ROLE OF FERROUS OXIDIZING BACTERIA TO CO-PRECIPITATION OF HEAVY METALS (UNTERSUCHUNGEN ZUM VERHALTEN VON SCHWERMETALLEN IN GEWASSERN: 1. DIE BEDEUTUNG EISENOXIDIERENDER BAKTERIEN DUR DIE KOPRAZIPATION VON SCHWERMETALLEN),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
V. G. Gunkel.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 489-515, February 1986. 11 fig, 1 tab, 34 ref.

Descriptors: *Path of pollutants, *Heavy metals, *Lakes, *Iron bacteria, Plankton, Berlin, West Germany, Siderocapsa treubii, Biomass, Stratification, Iron, Manganese, Aluminum, Zinc, Nickel, Copper, Oxygen deficit.

Occurrence of planktonic iron oxidizing bacteria is given for two urban lakes in Berlin (West) with different man made charge. Dominant genus of iron oxidizing bacteria is Siderocapsa Treubii in these lakes, besides Ochrobium tectum regularly occurs during the year. Planctomyces bekefii and Metallogenium personatum are periodically found with low quantity. Siderocapsa treubii reaches high densities up to 17,000 colonies/ml, whereas Ochrobium tectum occurs with less than 1,000 colonies/ml. In summer during stratification of the lakes Siderocapsa shows a vertical stratification of number of colonies and of biomass. The stratification is more significant when the hypolimnion becomes anoxic. The maximum of Siderocapsa treubii occurs in the oxic area directly above the anoxic water body. At the same time an increase in colony number and biomass of Siderocapsa is found during period of redox chemical mobilization of iron and manganese. These results indicate that distribution of Siderocapsa treubii in the lake is not influenced by magnitude of oxygen content of water. The stratification of Siderocapsa treubii is a consequence of sedimentation in stratified lakes as well as of a rise of colonies from the anoxic water body after solution of deposition on cells. This leads to an internal iron and manganese cycling in lakes. The method of Energy Dispersive X-Ray Microanalysis with Scanning Electron Microscopy (SEM-EDS) is applied to ferric hydroxide crusts of Siderocapsa treubii. The crusts mainly consist of iron, sometimes small amounts of manganese are detectable. Aluminum and zinc occur in all samples with high concentrations, while titan, nickel and copper sometimes occur with small amounts. Obviously these metals are adsorbed to the ferric hydroxide crusts. (Lantz-PTT)
W86-04188

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: MODEL DEVELOPMENT AND PARAMETER SENSITIVITY,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
J. C. Crittenden, N. J. Hutzler, and D. G. Geyer.
Water Resources Research WRERAO, Vol. 22, No. 3, p 271-284, March 1986. 8 fig, 2 tab, 38 ref. EPA Contract No. R809464-01-0 and NSF Grant No. CEE-8200213.

Descriptors: *Organic compounds, *Groundwater movement, *Model studies, *Groundwater pollution, *Path of pollutants, Hydrologic models, Soil columns, Mathematical studies, Sensitivity analysis, Soil absorption capacity, Saturated soils.

A model which includes the transport and retardation mechanisms of advective flow, axial dispersion, liquid-phase mass transfer, diffusion into immobile liquid, and local adsorption equilibrium, was developed to describe the migration of nondegradable, organic chemicals through a column of saturated, aggregated soil. A range of simplifying assumptions were explored to assess the relative importance of the various mechanisms. Solutions to the model were either adapted from the literature or derived from mass balances and mass transfer principles. The most general form of the model required the development of numerical solutions. Soil column breakthrough predictions in terms of relative concentration as a function of total column pore volumes fed can be characterized by seven independent dimensionless parameters: the Peclet number, the Stanton number, a pore diffusion modulus, a surface diffusion modulus, an adsorbed solute distribution ratio, an immobile fluid solute distribution ratio, and the Freundlich parameter 1/n. For a strongly adsorbed chemical in long soil columns, a fifteen fold decrease of the Peclet number, a fivefold decrease of the Stanton number, or a onefold decrease in either the pore diffusion modulus or the surface diffusion modulus have an equivalent effect on the spreading of the breakthrough curve. The breakthrough curve tends to sharpen for favorably adsorbed chemical species ($1/n<1.0$) and spread when adsorption is unfavorable ($1/n>1.0$). The movement of chemical is retarded as the solute distribution ratios increase. A sensitivity analysis of model parameters, which were derived from literature correlations, column geometry, soil adsorption isotherms, and breakthrough curves, showed that adsorption capacity, adsorption intensity, and aggregate geometry have the greatest effect on chemical retardation and spreading, while liquid-phase mass transfer has little effect. (See also W86-04191) (Lantz-PTT)
W86-04190

TRANSPORT OF ORGANIC COMPOUNDS WITH SATURATED GROUNDWATER FLOW: EXPERIMENTAL RESULTS,
Michigan Technological Univ., Houghton. Dept. of Civil Engineering.
N. J. Hutzler, J. C. Crittenden, and J. S. Gierke.
Water Resources Research WRERAO, Vol. 22, No. 3, p 285-295, March 1986. 7 fig, 5 tab, 19 ref. EPA Grant No. R809464-01-0.

Descriptors: *Organic compounds, *Groundwater movement, *Model studies, *Groundwater pollution, *Path of pollutants, Hydrologic models, Soil columns, Mathematical studies, Sensitivity analysis, Soil absorption capacity, Groundwater pollution, Saturated soils.

Measured breakthrough and elution curves for trichloroethene, bromoform, and chloride in columns of a sandy loam soil were compared to various models describing one-dimensional chemical transport through saturated soil columns. The local equilibrium model and the segregated flow model approximate the retardation of organic chemicals but do not account for the amount of spreading seen in the breakthrough and elution data. A dispersed flow, local equilibrium model (DFLEM) could simulate the breakthrough of the organic chemicals and tracer, but only if the axial dispersion coefficient was adjusted to match the breakthrough data. Existing correlations for axial dispersion based on soil and fluid properties could not predict the apparent dispersion seen in the miscible displacement experiments. A dispersed flow, pore and surface diffusion model (DFPSDM) could also simulate the chemical breakthrough if an aggregate radius were adjusted to fit the data. Neither the adjusted radii nor the apparent dispersivities could be related to the hydraulic characteristics of the column or to soil properties. Both models were able to reasonably predict the elution of chemicals from the column when either an aggregate radius or an apparent dispersivity were estimated from the breakthrough data. Neither the DFLEM nor the DFPSDM were able to predict the increased asymmetry or the leftward shift of the breakthrough data when the average pore water velocity was increased from 12.0 to 36.6 cm/h. While the DFPSDM appears to be more phenomenologically correct, this work suggests that an additional kinetic mechanism should be included in the model. (See also W86-04190) (Lantz-PTT)
W86-04191

MODELING CONTAMINATION OF SHALLOW UNCONFINED AQUIFERS THROUGH INFILTRATION BEDS,
Massachusetts Univ., Amherst. Dept. of Civil Engineering.
D. W. Ostendorf.
Water Resources Research WRERAO, Vol. 22, No. 3, p 375-382, March 1986. 5 fig, 1 tab, 17 ref, append.

Descriptors: *Unconfined aquifers, *Infiltration, *Path of pollutants, *Hydrologic models, Groundwater pollution, Simulation analysis, Flow pattern, Chloride, Nitrogen, Boron, Detergents, Wastewater treatment, Massachusetts.

The transport of a simply reactive contaminant through an infiltration bed and underlying shallow, one-dimensional, unconfined aquifer with a plane, steeply sloping bottom in the assumed absence of dispersion and downgradient dilution, is modeled. The effluent discharge and ambient groundwater flow under the infiltration beds are presumed to form a vertically mixed plume marked by an appreciable radial velocity component in the near field flow region. The near field analysis routes effluent contamination as a single linear reservoir whose output forms a source plane for the one-dimensional, far field flow region downgradient of the facility; the location and width of the source plane reflect the relative strengths of ambient flow and effluent discharge. Modeled are far field contaminant transport, using an existing method of characteristics solution with frame speeds modified by recharge, bottom slope, and linear adsorption, and concentrations reflecting first-order reaction kinetics. The near and far field models simulate transport of synthetic detergents, chloride, total nitrogen, and boron in a contaminant plume at the Otis Air Force Base sewage treatment plant in Barnstable County, Massachusetts, with reasonable accuracy. (Lantz-PTT)
W86-04201

CONSTRAINTS ON THE VALIDITY OF EQUILIBRIUM AND FIRST-ORDER KINETIC TRANSPORT MODELS IN STRUCTURED SOILS,
Virginia Polytechnic Inst. and State Univ., Blacksburg.
For primary bibliographic entry see Field 2G.
W86-04203

EFFECTIVE AND INEXPENSIVE GAS-DRIVE GROUND WATER SAMPLER,
GHR Environmental, Inc., New Bedford, MA.
W. R. Norman.
Groundwater Monitoring Review, Vol. 6, No. 2, p 56-60, Spring 1986. 3 fig, 1 tab, 5 ref.

Descriptors: *Groundwater pollution, *Water sampling, *Drilling, *Cost analysis, Groundwater management, Piezometric heads, Aquifers, Geohydrology, Measuring instruments.

Groundwater scientists engaged in the assessment of contaminant occurrence and migration are faced with a number of practical problems. These problems include, but are not limited to: (1) escalating drilling costs, (2) labor costs for proper sampling of monitoring wells, (3) collection of groundwater samples that are representative of aquifer conditions, and (4) accurate delineation of hydrogeologic regimes and the areal and vertical distribution of groundwater contaminants. In response to these problems, a number of groundwater sampling devices have been developed. One device is a gas-driven groundwater sampler developed for multi-level installation. Use of these samplers have been shown to decrease project costs and allow easy collection of high quality samples. However, the currently available samplers are relatively expensive, some of them operate on a closed check valve system, which does not allow determination of

piezometric heads in aquifers with fluctuating water tables and they are not adaptable to design changes in the field necessitated by site specific hydrogeologic conditions. An effective gas-driven sampler has been designed, which accomplishes the same objectives as the commercially available models, but is on the average, one-tenth the cost of currently available samplers. It offers the advantages of being more cost-effective than commercially available models, has an open check valve system to allow measurements of water table fluctuation and is easily adaptable in the field to meet site-specific hydrogeologic conditions. (Lantz-PTT)
W86-04208

FACTORS WHICH AFFECT SOIL-PORE LIQUID: A COMPARISON OF CURRENTLY AVAILABLE SAMPLERS WITH TWO NEW DESIGNS,
W. J. Hornby, J. D. Zabcik, and W. Crawley.
Groundwater Monitoring Review, Vol. 6, No. 2, p 61-66, Spring 1986. 9 fig, 27 ref.

Descriptors: *Soil water, *Soil porosity, *Water sampling, *Measuring instruments, *Soil-pure liquid samples, Monitoring, Groundwater pollution, Aeration zone.

The primary use of soil-pore liquid (SPL) monitoring is to detect pulses of contaminants moving through the unsaturated zone to groundwater. This type of pollutant detection monitoring is required at hazardous and some non-hazardous waste land treatment facilities throughout the United States. Presently available suction and free drainage SPL samplers were compared with two new SPL sampler designs for use in unsaturated zone monitoring programs. Comparisons and recommendations for appropriate SPL monitoring equipment were based on factors that influence sample quality. These factors are: (1) The nature of the matrix being sampled, (2) The nature of constituent being monitored, (3) Seasonal and site managerial influences on water movement, and (4) Site condition influence on available options for installation of monitoring equipment. (Lantz-PTT)
W86-04209

SAMPLING FOR TOXIC CONTAMINANTS IN GROUND WATER,
Kennedy/Jenks Engineers, San Francisco, CA.
G. W. Bryden, W. R. Mabey, and K. M. Robine.
Groundwater Monitoring Review, Vol. 6, No. 2, p 67-72, Spring 1986. 3 fig, 8 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Water sampling, Literature review, Groundwater management, Water quality control.

In the course of developing numerous groundwater monitoring programs, standardized protocols for groundwater monitoring well sampling, using proven technology and drawing from a consensus of research by leading groundwater specialists, have been instituted. This paper is an overview of findings from literature review and practical experience. Groundwater sampling techniques are related to the practical application of sampling for toxic contaminants in groundwater. Choices are addressed that must be made in choosing equipment for a particular project by going through a step-by-step procedure for collecting a groundwater sample from a typical monitoring well. Groundwater sampling topics that are discussed include: choice of equipment for purging and sampling a well, monitoring for purged groundwater indicators and quality assurance/quality control. (Lantz-PTT)
W86-04210

LOW-COST APPARATUS FOR ON-SITE MONITORING OF METHANE IN GROUND WATER,
Allegheny Coll., Meadville, PA. Dept. of Geology.
S. S. Harrison.
Groundwater Monitoring Review, Vol. 6, No. 2, p 73-76, Spring 1986. 4 fig, 1 tab, 2 ref.

Descriptors: *Monitoring, *Groundwater pollution, *Cost-analysis, *Methane, Gas volume monitoring apparatus, Laboratory equipment, Pressure-measuring instruments, Pennsylvania, New York.

An upsurge in oil- and gas-well drilling in northwestern Pennsylvania and western New York has been accompanied by several incidents of contamination of groundwater by methane. Determining which well is causing the contamination is extremely difficult if more than one gas or oil well is present in the area. The fact that the solubility of methane decreases as the pressure on groundwater decreases provides a quantitative basis for monitoring changes in the amount of methane in the groundwater. Quantitative measurements of the volume of methane given off by groundwater pumped from a well as the water enters atmospheric pressure permits detection of temporal changes in the gas content which are too subtle to be detected visually. These gas volume changes may, in some cases, be correlated with variations in the pressure of methane in the annulus of nearby individual gas/oil wells and may then provide a means of pinpointing the gas/oil well that is causing the methane contamination. The basic principle of the gas-volume monitoring apparatus (GVMA) described in this paper is that as a measured amount of groundwater enters atmospheric pressure the gas which comes out of solution is trapped and measured. The GVMA can be constructed of materials costing less than $100 and requires no special skills to assemble or operate. (Lantz-PTT)
W86-04211

NEW VALVED AND AIR-VENTED SURGE PLUNGER FOR DEVELOPING SMALL-DIAMETER MONITOR WELLS,
Battelle Project Management Div., Richland, WA. Office of Hazardous Waste Management.
R. Schalla, and R. W. Landick.
Groundwater Monitoring Review, Vol. 6, No. 2, p 77-80, Spring 1986. 5 fig.

Descriptors: *Monitoring wells, *Surge plungers, *Valves, Drilling fluids, Drilling, Prototypes, Sand, Cost analysis, Decontamination, Hazardous materials, Wells, Groundwater potential.

To properly develop 2-inch diameter monitor wells, large volumes of water, drilling fluids and fine-grained materials must be removed from the sandpack and surrounding formation over short periods of time. A valved and air-vented surge plunger has been designed which can be used to effectively develop 2-inch diameter wells. The valving and air-venting concepts for surge plungers are not new, but the design concepts had to be refined to facilitate their efficient use in 2-inch diameter wells. Prototypes of the surge plunger have been field tested. The tests indicate that the design is both effective and durable as a result of its dimensions, configurations and materials. The surge plunger has advantages over other popular methods of well development, particularly air-lifting. These advantages include the following: (1) Auxiliary equipment or tools are not required, such as an air compressor and hand tools, (2) Air is not introduced into the formation unless the unit is lowered into the screened interval, (3) Setup, shutdown and decontamination time can be done in minutes by one person, (4) Discharge of hazardous fluids can be piped directly and safely into drums using a 'T' bypass, and (5) Large volumes of water can be removed in a short period of time. The preceding advantages are in addition to the fact that surging is a very effective means of developing wells. (Lantz-PTT)
W86-04212

WASTE TREATMENT/DISPOSAL SITE EVALUATION PROCESS FOR AREAS UNDERLAIN BY CARBONATE AQUIFERS,
Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5G.
W86-04219

ANALYSIS OF A CONTAMINATED BEDROCK AQUIFER BY MEANS OF A PACKER AND ATTEMPTS AT REMEDIATION USING A PACKER,
Olin Chemical Group, Charleston, TN.
K. D. Hiltgen, and S. E. Anderson.
Ground Water Monitoring Review, Vol. 6, No. 2, p 122-125, Spring 1986. 3 fig, 2 tab, 1 ref.

Descriptors: *Bedrock, *Aquifers, *Packers, *Groundwater pollution, Dolomite, Path of pollutants, Geologic fractures, Pumps, Water pollution control.

A dolomite bedrock aquifer in the Northeast has been contaminated with volatile organic compounds. These compounds have made their way into pumping wells, which contain total volatile organic concentrations averaging 2 to 4 ppm. The source of these organics has not been positively identified. Television video logs show considerable vertical fractures in the upper 20 feet of the bedrock aquifer. Below this, where bedrock is more consolidated, there are a few areas of caverns and large crevices, some of which are 10 feet thick. It was first thought that perhaps the organics were entering the well through a few of the crevices that could be grouted off from the remainder of the aquifer. An inflatable packer was fabricated, so that isolated sections of the well could be sampled. Using video logs as guides, vertical sections of the well were sampled and the centerline of the plume was determined. The packer was comprised of two steel rim supports that supported innertubes. The two packers were separated with 4 ft of steel rod. Placed on top of the lower section was a standard submersible well pump that could pump a flow rate of 10 gpm. The packer assembly was lowered into the well with a winch and then at selected locations the packer was inflated with air to 50 psig. The submersible pump was turned on and allowed to pump the section for 30 minutes to adequately purge the area and obtain a representative sample. The results of the sampling showed the maximum concentrations to be at 95 feet below the surface. The entire aquifer is 125 feet thick. This means the lower third contains the organics. To determine what vertical section supplies the most water, the well was divided into thirds and a material balance was run, using three different compounds. From the analysis, it was determined that a packer placed at the 70 foot level and only pumping from that section will reduce organics concentration by a factor of 10 and reduce flow only by 20%. (Lantz-PTT)
W86-04220

CHLORINATED CARBOXYLIC ACIDS IN SOFTWOOD KRAFT PULP SPENT BLEACH LIQUORS,
Svenska Traeforskningsinstitutet, Stockholm.
For primary bibliographic entry see Field 5A.
W86-04224

KINETICS OF ALUMINUM FLUORIDE COMPLEXATION IN ACIDIC WATERS,
Maine Univ. at Orono. Dept. of Chemistry.
B. J. Plankey, H. H. Patterson, and C. S. Cronan.
Environmental Science and Technology, Vol. 20, No. 2, p 160-165, February 1986. 6 fig, 4 tab, 22 ref. EPRI Contract No. RP-2365-01.

Descriptors: *Kinetics, *Aluminum flouride, *Acid rain, *Acidic water, Aluminum, Path of pollutants, Water pollution effects, Hydrogen ion concentration, Temperature effects.

Acidic deposition has an important effect on the transport and speciation of soluble aluminum. Toxicity of aqueous aluminum seems to be strongly dependent on aluminum speciation and the presence of complexing ligands such as flouride. A study of the complex formation kinetics of $AlF(2+)$ in the environmentally significant pH range 2.9-4.9 is reported. Five important paths for $AlF(2+)$ formation are described. Two of these are independent of $(H+)$, one is dependent on $1/(H+)$, and one is dependent on $(H+)$. The pH and temperature dependencies of the overall rate of reaction are discussed along with environmental implications for areas subjected to acidic deposition. (Lantz-PTT)
W86-04226

WATER SOLUBILITY OF 2,3,7,8-TETRACHLORODIBENZO-P-DIOXIN,
Syntex Research, Inc., Palo Alto, CA.
L. Marple, R. Brunck, and L. Throop.
Environmental Science and Technology, Vol. 20, No. 2, p 180-182, February 1986. 2 tab, 11 ref.

Descriptors: *Solubility, *2,3,7,8-Tetrachlorodibenzo-p-dioxin, *Chemical analysis, Carbon radioisotopes, Radio labelling, Dioxin, Gas chromatography, Mass spectrometry, Octanol-water partition coefficient, Yalkowsky's equation, Statistical analysis.

Vacuum deposition of a solid film onto a glass surface and equilibration of this film with water are the basis of a method that was used to measure the water solubility of 2,3,7,8-tetrachlorodibenzo-p-dioxin. Films of both 14-C radiolabeled and unlabeled dioxin were prepared so that solubilized material could be measured by radioactivity as well as by capillary gas chromatography (GC)/mass spectrometry(MS) techniques. The averages of solubility values for radiolabeled and unlabeled dioxin were 3.9 times 10 the -11 M (12.5 parts per trillion) and 6.0 times 10 to the -11 M (19.3 parts per trillion), respectively. The solubility values lie within the values predicted from Yalkowsky's K sub ow solubility equation of best fit for chlorinated hydrocarbons and the available estimates for the octanol-water partition coefficient, K sub ow. (Lantz-PTT)
W86-04227

INSIGHT INTO THE MECHANISM OF ACCUMULATION OF ARSENATE AND PHOSPHATE IN HYDRO LAKE SEDIMENTS BY MEASURING THE RATE OF DISSOLUTION WITH ETHYLENEDIAMINETETRAACETIC ACID,
Auckland Univ. (New Zealand). Dept. of Chemistry.
J. Aggett, and L. S. Roberts.
Environmental Science and Technology, Vol. 20, No. 2, p 183-186, February 1986. 4 fig, 5 tab, 8 ref.

Descriptors: *Path of pollutants, *Arsenic compounds, *Phosphates, *Accumulation, *Lake sediments, Rate of dissolution, Lake Ohakuri, New Zealand, Ethylenediaminetetraacetic acid, Iron, Aluminum, Calcium, Manganese, Silicon, Hydrogen ion concentration.

The mechanism of accumulation of arsenic and phosphate on sediments in Lake Ohakuri in the North Island of New Zealand has been examined by comparing the rates of dissolution of the anions with the rates of dissolution of the matrix elements iron, aluminum, calcium, manganese, and silicon, when samples were reacted with ethylenediaminetetraacetic acid (EDTA) at the natural pH of the sediments. On the basis of dissolution rate data alone it has been concluded that solid calcium and manganese species are not involved in the accumulation process. The same conclusion has been reached for aluminum oxides after additional consideration of the relative molar amounts of aluminum, arsenic, and phosphate dissolved. A very close correlation was observed between the rates of dissolution of the anions and that of iron. This, together with the observation of that iron not dissolved by EDTA was subsequently dissolved by Tamm's reagent, suggests that the most important mechanisms of accumulation involves some interaction between hydrous iron oxides and the anions. From the constancy of the iron:arsenic and iron:phosphate ratios during dissolution it has been concluded that arsenic and phosphate are incorporated into these sediments by coprecipitation at the time of formation of the hydrous oxides rather than by adsorption on existing surfaces. (Lantz-PTT)
W86-04228

AIRBORNE DIOXINS AND DIBENZOFURANS: SOURCES AND FATES,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
J. M. Czuczwa, and R. A. Hites.
Environmental Science and Technology, Vol. 20, No. 2, p 195-200, February 1986. 6 fig, 1 tab, 24 ref. DOE Grant 80-EV-10449.

Descriptors: *Air pollution, *Dioxins, *Dibenzofurans, *Path of pollutants, *Water pollution sources, Lake Ontario, Lake Erie, Siskiwit Lake, Polychlorinated dibenzo-p-dioxins, Polychlorinated dibenzofurans.

Polychlorinated dibenzo-p-dioxins (PCDD) and dibenzofurans (PCDF) were found in urban air particulates and Great Lakes sediments. In all samples, octachlorodibenzo-p-dioxin predominated. Combustion of municipal and chemical wastes appear to be the most likely source of these compounds. When these data were compared with dioxins and dibenzofurans found in combustion sources, evidence was found for the loss of the less chlorinated dioxins and dibenzofurans. Using principal components analysis, it was found that the most likely source of PCDD and PCDF to a western Lake Ontario site was pentachlorophenol production. Historical fluxes of dioxins and dibenzofurans to sediment cores from Lake Erie and Siskiwit Lake (Isle Royale) suggest that the incineration of chloro aromatics has been an important source of dioxins and dibenzofurans. (Lantz-PTT)
W86-04230

SELECTIVE RECOVERY OF GOLD AND OTHER METAL IONS FROM AN ALGAL BIOMASS,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
D. W. Darnall, B. Greene, M. T. Henzi, J. M. Hosea, and R. A. McPherson.
Environmental Science and Technology, Vol 20, No. 2, p 206-208, February 1986. 2 fig, 20 ref.

Descriptors: *Gold, *Silver, *Mercury, *Biomass, Algae, Water pollution effects, Path of pollutants, Chlorella vulgaris, Hydrogen ion concentration, Copper, Zinc, Bioaccumulation, Biosorption.

In determining the abilities of microorganisms to remove metal ions from water, a number of investigators have shown that different metal ions bind to cell walls of bacteria, fungi, and algae. It has been observed that the pH dependence of binding of Au(3+), Ag(+), and Hg(2+) to the algae Chlorella vulgaris is different than the binding of other metal ions. Between pH 5 and 7,a variety of metal ions bind strongly to the cell surface. Most of these algal-bound metal ions can be selectively desorbed by lowering the pH to 2; however, Au(3+), Hg(2+), and Ag(+) are all bound strongly at pH 2. To elute these ions from the algal surface, addition of a strong ligand at different pHs is required. Algal-bound gold and mercury can be selectively eluted by using mercaptoethanol. An elution scheme is demonstrated for the binding and selective recovery of Cu(2+), Zn(2+), Au(3+), and Hg(2+) from an equimolar mixture. (Lantz-PTT)
W86-04231

SHORT-TERM STABILITY OF TRACE METALS IN ESTUARINE WATER SAMPLES,
Water Research Centre, Medmenham (England). Medmenham Lab.
For primary bibliographic entry see Field 2L.
W86-04232

RELATIONSHIP OF GEOLOGY, PHYSIOGRAPHY, AGRICULTURAL LAND USE, AND GROUND-WATER QUALITY IN SOUTHWEST GEORGIA,
Florida Sinkhole Research Inst., Orlando.
B. F. Beck, L. Asmussen, and R. Leonard.
Groundwater GRWAAP, Vol. 23, No. 5, p 627-634, September-October 1985. 5 fig, 25 ref.

Descriptors: *Groundwater Pollution, *Path of Pollutants, *Agricultural Runoff, *Nitrates, *Georgia, Well Water, Chemical Properties, Hardness, Alkalinity, Physical Properties, Cropland, Confined Aquifers, Fertilizers, Safe Drinking Water Standards.

A study was conducted to assess the groundwater quality in a sandy aquifer in southwest Georgia and to determine whether variations in quality are related to variations in agricultural land use. Water samples were collected from 34 wells in the Claiborne aquifer. Land use/cover is principally forest, wetland, or agriculture. The aquifer is exposed surficially to the northwest but dips beneath confining beds to the southeast. Well water was analyzed in the field for pH, electrical conductivity, alkalinity, hardness, and temperature, and in the laboratory for Cl, NH4, NO3, total N, total P, ortho-P, SO4, K, Na, Ca, Mg, and Fe. Hardness gradually increases from 5 mg/l updip to 162 mg/l downdip and bicarbonate alkalinity follows the same trend. Higher than normal nitrate concentrations (4-6 mg/l) were found in ground water in the exposed updip portion of the aquifer in areas where agricultural land use for cropland is high. However, in forest-covered areas, ground water in the exposed portion of the aquifer contains nitrate concentrations similar to the confined areas (<1 mg/l). Other chemical constituents measured do not show a discernible pattern of variation. One well near a fertilizer storage facility contained nitrate concentrations exceeding the Safe Drinking Water Standards, and other wells in the agricultural portion of the outcrop belt may seasonally exceed these limits. It appears that some contamination has been occurring for many years, although it has not reached a deleterious level. (Peters-PTT)
W86-04240

MIGRATION OF CHLOROPHENOLIC COMPOUNDS AT THE CHEMICAL WASTE DISPOSAL SITE AT ALKALI LAKE, OREGON - 2. CONTAMINANT DISTRIBUTIONS, TRANSPORT, AND RETARDATION,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
R. L. Johnson, S. Brillante, L. M. Isabelle, J. E. Houck, and J. F. Pankow.
Groundwater GRWAAP, Vol. 23, No. 5, p 652-666, September-October 1985. 11 fig, 2 tab, 25 ref. EPA Grant 808272.

Descriptors: *Path of Pollutants, *Chlorophenols, *Chlorinated Hydrocarbons, *Groundwater Pollution, *Alkali Lake, Oregon, Phenols, Sorption, Land Disposal, Chemical Wastes, Soil Density, Soil Porosity, Soil Properties.

The behaviors of five chlorophenols and three chlorophenoxyphenols (CPPs) have been investigated at the chemical waste disposal site at Alkali Lake, Oregon. All of the compounds demonstrated similar trends in areal distribution hydraulically downgradient from the site. The transport distances for the di- and trichlorohenols were influenced greatly by their ionization in the high pH (10) ground water. In batch equilibrium experiments, these compounds were found to have equilibrium partition coefficient values of 0.0 for the soil and ground water taken from the site. While also largely ionized at pH 10, a tetrachlorophenol, pentachlorophenol, and the CPPs demonstrated substantial sorption in the batch equilibrium experiments as well as retardation relative to the di- and trichlorophenols at the site. While the trend in observed retardation of the chlorophenolics is correct, the magnitudes of the relative retardations are less than predicted from the batch experiment results. This is probably the result of irregularities in the hydraulic conductivity values downgradient of the site. These results show, for the first time, well-behaved concentration contours embodying compound-dependent retardation in the transport of sorbing and nonsorbing organic compounds from an existing waste disposal site. (Peters-PTT)
W86-04242

RIPARIAN LOSSES OF NITRATE FROM AGRICULTURAL DRAINAGE WATERS,
North Carolina Agricultural Research Service, Raleigh.
T. C. Jacobs, and J. W. Gilliam.
Journal of Environmental Quality, Vol. 14, No. 4, p 472-478, October-December 1985. 3 fig, 4 tab, 25 ref.

Descriptors: *Agricultural Runoff, *Agricultural Watershed, *Nitrate, *Groundwater Runoff, Cropland, Surface Drainage, Drainage Effects, Subsur-

face Drainage, North Carolina, Denitrification, Tele Drainage.

Nitrate concentrations in shallow groundwaters beneath cultivated fields in the North Carolina Coastal Plain and in the drainage waters from those fields were examined to determined the fate of nitrogen lost to drainage waters. From a watershed where well- and moderately well-drained soils dominate agricultural fields, 10 to 55 kg/ha/yr NO3-N moved from the fields in subsurface drainage water. However, most fields are bordered by forested buffers between the cultivated areas and streams which consist of poorly and very poorly-drained soils covered by dense vegetation. A substantial part of the nitrate in the drainage water appears to be denitrified in the buffer strip and assimilation by vegetation is insignificant. Buffer strips of <16 m are effective for inducing significant losses of nitrate before drainage water reaches the stream. A field containing subsurface drainage tubing which emptied into open ditches moved nitrogen into surface water than fields without subsurface drainage improvements. From a Lower Coastal Plain watershed, a dense clay layer below the surface horizon reduced subsurface drainage resulting in total losses from the field of only 6 to 12 kg/ha/yr NO3-N, mostly in surface runoff. The extensive floodplain of the natural stream had a high capacity to reduce large quantities of N but the low total loss from the watershed is largely a result of low input to the drainage water from nonpoint sources. (Author's abstract)
W86-04260

MODELING EXPOSURE ROUTES TO MAN OF TRACE METALS ASSOCIATED WITH ACID PRECIPITATION,
Monitoring and Assessment Research Centre, London (England).
B. G. Bennett.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 89-92, November 1985. 1 tab, 11 ref.

Descriptors: *Model studies, *Acid rain, *Trace metals, Time-dependent modeling, Path of pollutants, Mercury, Environmental effects.

Pollutant metals released to the environment disperse and interact in various ways before arriving at sensitive receptors. Modeling of pollutant behavior may be by time-dependent or time-independent means. Modeling of exposure routes implies the formulation of a simplified arrangement of system components and the expression of relationships between concentrations and exposures in the environment and in the receptor. There are two basic approaches to modeling. One may use either a time-dependent or a time-independent method. The method of choice is determined by the underlying data base. The time-independent, exposure commitment method requires a less extensive data base and can begin with general associations between environmental concentrations or fluxes. Such assessments for representative background conditions have been performed for most of the metals associated with acid precipitation. Examples are given here for cadmium and mercury. (Lantz-PTT)
W86-04266

ALUMINUM IN ACIDIC SURFACE WATERS: CHEMISTRY, TRANSPORT, AND EFFECTS,
Syracuse Univ., NY. Dept. of Civil Engineering.
C. T. Driscoll.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 93-104, November 1985. 9 fig, 2 tab, 69 ref.

Descriptors: *Acid rain, *Acidic water, *Chemical analysis, *Path of pollutants, Water pollution effects, Mineral acids, Aluminum, Watersheds, Surface waters, Hydrogen ion concentration, Toxicity, Organic compounds.

Ecologically significant concentrations of Al have been reported in surface waters draining 'acid-sensitive' watersheds that are receiving elevated inputs of acidic deposition. It has been hypothesized that mineral acids from atmospheric deposition have remobilized Al previously precipitated within the soil during soil development. This Al is then thought to be transported to adjacent surface waters. Dissolved mononuclear Al occurs as aquo Al, as well as OH(-), F(-), SO4(2-), and organic complexes. Although past investigations have often ignored non-hydroxide complexes of Al, it appears that organic and F complexes are the predominant forms of Al in dilute (low ionic strength) acidic surface waters. The concentration of inorganic forms of Al increases exponentially with decreases in solution pH. The concentration of organic forms of Al, however, is strongly correlated with variations in organic carbon concentration of surface waters rather than pH. Elevated concentrations of Al in dilute acidic waters are of interest because: Al is an important pH buffer; Al may influence the cycling of important elements like P, organic carbon, and trace metals; and Al is potentially toxic to aquatic organisms. An understanding of the aqueous speciation of Al is essential for an evaluation of these processes. (Lantz-PTT)
W86-04267

POTENTIAL IMPACT OF ACID PRECIPITATION ON ARSENIC AND SELENIUM,
North Carolina Univ. at Chapel Hill. Dept. of Pathology.
For primary bibliographic entry see Field 5C.
W86-04268

EFFECTS OF ACIDIFICATION ON THE MOBILITY OF METALS AND METALLOIDS: AN OVERVIEW,
Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
For primary bibliographic entry see Field 5C.
W86-04269

SOLUTE-TRANSPORT SIMULATION OF BRACKISH-WATER INTRUSION NEAR BALTIMORE, MARYLAND,
F. H. Chappelle.
Ground Water GRWAAP, Vol. 24, No. 3, p 304-311, May-June 1986. 8 fig, 11 ref.

Descriptors: *Brackish water, *Groundwater pollution, *Simulation models, *Solute transport, *Baltimore, *Saline water intrusion, Maryland, Aquifers, Patapsco River, Patuxent aquifer, Plumes, Model studies.

The Patuxent aquifer presently contains a circular plume of brackish-water contamination that is about 5 miles in diameter. This plume is centered on the Patapsco River estuary and is characterized by chloride concentrations that range up to 5,000 mg/l. Borehole data demonstrates that erosional channels provide conduits for brackish water to seep from the Patapsco River into the Patuxent aquifer, when aquifer water levels are lower than river water levels. A two-dimensional areal solute-transport model of the Patuxent aquifer was used to estimate the future movement of the brackish-water plume based on alternative strategies of aquifer use. Model simulations suggest that the plume will not spread rapidly if present pumping patterns are continued. Furthermore, sharply curtailing pumpage in the Baltimore area will probably not reduce the size of the plume, although this strategy may slightly decrease the spreading rate. While the plume is presently remaining nearly stationary, new pumping centers southeast of Baltimore could cause brackish water to migrate in that direction, significantly increasing the size of the plume. (Lantz-PTT)
W86-04274

CHROMIUM MIGRATION THROUGH SLUDGE-TREATED SOILS,
California Univ., Santa Cruz. Dept. of Earth Sciences.
S. J. Dreiss.
Ground Water GRWAAP, Vol. 24, No. 3, p 312-321, May-June 1986. 8 fig, 4 tab, 29 ref. EPA Agreement No. 68-03-2976.

Descriptors: *Chromium, *Path of pollutants, *Land disposal, *Sludge disposal, Tannery wastes, Industrial wastes, Nitrates, Soil water, Santa Cruz, California.

A five-year project was initiated in September 1980 by the EPA and the Tannery Council of America, to investigate the feasibility of using land treatment to dispose of chromium tanning sludges. These sludges contain high concentrations of Cr, in the range of 21,000 to 55,000 ppm on a dry weight basis. Chromium could migrate in soil waters at a land treatment site as either a soluble Cr(VI) species, HCrO4(-) or CrO4(2-), or as Cr(III) or Cr(VI) in soluble complexes with organic or inorganic substances. Field measurements of Cr fluxes at an experimental test site near Santa Cruz, California indicate that Cr in tannery sludges exhibits a very low mobility. Less than 0.1% of the total Cr applied to a test plot was transported through the upper soil zone during a three-month period. However, the sludge applications introduced high concentrations of nitrates and major cations. Estimates of contaminant fluxes based on measured concentrations in soil water collected with porous cup samplers contain large uncertainties. In addition to potential errors in moisture flux computations, chemical reactions in the cups can significantly alter the composition of soil water samples. (Lantz-PTT)
W86-04275

CONTAMINANT MOVEMENT UNDER PUMPAGE-RECHARGE CONDITION IN STEADY GROUNDWATER FLOW SYSTEM,
Asian Inst. of Tech., Bangkok (Thailand). Div. of Water Resources Engineering.
A. D. Gupta, and P. R. O. Shrestha.
Ground Water GRWAAP, Vol. 24, No. 3, p 342-350, May-June 1986. 11 fig, 16 ref.

Descriptors: *Path of pollutants, *Pumpage, *Recharge, *Groundwater movement, Mathematical analysis, Galerkin technique, Mathematical models, Water pollution sources, Water pollution effects.

The transient movement of contaminants under pumpage and recharge conditions in steady groundwater flows in a vertical cross section of a confined aquifer, is simulated using a finite-element numerical model based on the Galerkin technique. Various factors like time step, space increment, and boundary conditions, which affect the accuracy of the numerical solution, are considered in validating results of the numerical model with results of an analytical solution. In general, as the dispersivity value increases, contaminants move further through the flow system. However, with time, due to pumpage, concentration at the well and downstream, reaches a relatively low steady-state value instead of approaching the input concentration as in the case of uniform flow. If the waste input is discontinued, with pumpage on the downstream side, the previously contaminated region is restored to a pure state faster as the well acts as a sink for mass flux. Without pumpage, the contaminating plume transports with the flow further downstream and disperses with increased time. The effect of pumpage is quite significant insofar as restricting the movement of contaminant further downstream is concerned. For certain practical situations, this is an effective means of controlling the movement of contaminated groundwater. The inference drawn from this study provides a general idea on the effectiveness of a hydraulic barrier for the retardation of contaminant movement which can assist in planning a suitable groundwater quality management policy. (Lantz-PTT)
W86-04278

ANALYTICAL AND APPROXIMATE SOLUTIONS TO RADIAL DISPERSION FROM AN INJECTION WELL TO A GEOLOGICAL UNIT WITH SIMULTANEOUS DIFFUSION INTO ADJACENT STRATA,
Wisconsin Univ.-Milwaukee. Dept. of Civil Engineering.
C.-S. Chen.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1069-1076, August 1985. p 1069-1076, 4 fig, 31 ref.

Descriptors: *Injection wells, *Mathematical models, *Aquifers, *Aquitards, *Fate of pollutants, Path of pollutants, Groundwater pollution, Groundwater movement, Model studies, Models, Hydrological models, Mathematical equations.

Analytical and approximate solutions are developed for radial dispersion in aquifers with simultaneous diffusion into adjacent strata. Contaminants from the injection well are transported within the main aquifer by advection and mechanical dispersion, assuming a steady state and radially diverging groundwater flow field. The leakage of contaminants from the main aquifer to the aquitards is accounted for by molecular diffusion. A mathematical model consisting of two coupled differential equations is proposed to investigate concentration distributions in the main aquifer as well as in the adjacent aquitards. By making use of Laplace transforms, analytical solutions valid for small time periods are obtained without difficulty. To complement these analytical solutions concentration distributions for intermediate and large time intervals are determined approximately by numerically inverting the appropriate transformed solution in the Laplace domain with the Stehfest algorithm. Excellent agreement exists between analytical solutions and approximate solutions for small time intervals, supporting the validity of approximate solutions for intermediate and large time periods. It is shown that the diffusive leakage may significantly delay contaminant movement within the main aquifer at relatively large time periods. The solutions can be applied to study radial dispersion in granular aquifers bounded by relatively low permeability aquitards, or in planar fractures contained in porous formations. (Author's abstract)
W86-04304

GROUNDWATER MASS TRANSPORT AND EQUILIBRIUM CHEMISTRY MODEL FOR MULTICOMPONENT SYSTEMS,
Stanford Univ., CA. Dept. of Civil Engineering.
G. A. Cederberg, R. L. Street, and J. O. Leckie.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1095-1104, August 1985. p 1095-1104, 5 fig, 8 tab, 29 ref. EPA Contract No. CR-808857.

Descriptors: *Fate of pollutants, *Groundwater pollution, *Groundwater movement, *Path of pollutants, *Mathematical models, Numerical analysis, Mathematical studies, Ion transport, Ion exchange, Cadmium, Chlorides, Bromides, Mass transfer, Hydrologic models, Models, Solute transport.

A mass transport model, TRANQL, for a multicomponent solution in equilibrium with a groundwater system was developed for modeling the transport of contaminants through groundwater flow systems. The equilibrium interaction chemistry is posed independently of the mass transport equations which leads to a set of algebraic equations for the chemistry coupled to a set of differential equation for the mass transport. Significant equilibrium chemical reactions such as complexation, ion exchange, competitive adsorption, and dissociation of water may be modeled by TRANQL. A finite element solution is presented first for cadmium, chloride, and bromide transport in a one-dimensional column where complexation and sorption are considered. Second, binary and ternary ion exchange are modeled and compared to the results of other investigators. Results showed that TRANQL exhibited versatility, and could potentially be extended to a wide range of equilibrium reactions. (Geiger-PTT)
W86-04307

TRANSIENT MOVEMENT AND TRANSFORMATION OF CARBON SPECIES IN SOIL DURING WASTEWATER APPLICATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
For primary bibliographic entry see Field 5E.
W86-04311

FIELD EXAMPLE OF MEASURING HYDRODYNAMIC DISPERSION IN A SINGLE FRACTURE,
Atomic Energy of Canada Ltd., Ottawa (Ontario).
K. S. Novakowski, G. V. Evans, D. A. Lever, and K. G. Raven.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1154-1174, August 1985. 8 fig, 1 tab, 34 ref.

Descriptors: *Tracers, *Geologic fractures, *Solute transport, *Groundwater movement, Boreholes, Observation wells, Pump wells, Hydrologic models, Injection wells, Model studies, Flow velocity.

A field example of measuring the dispersive properties of a single fracture in fractured plutonic rock is presented. The experimental technique involves injecting a slug of conservative tracer into a 'steady' groundwater flow field established between a pumping and recharging borehole and monitoring the tracer breakthrough by sampling the withdrawal water directly. The breakthrough curves from two experiments were analyzed with a model which describes the flow field geometry either analytically or numerically and solves for hydrodynamic dispersion analytically. A longitudinal dispersivity of 1.40 m was estimated by fitting the model to each set of field data. The magnitude of the dispersion was determined to be independent of dispersive effects created by flow through the borehole instrumentation and thought to be purely hydrodynamic in nature. (Author's abstract)
W86-04314

FREQUENCY DOMAIN APPROACH TO WATER QUALITY MODELING IN GROUNDWATER: THEORY,
Utah State Univ., Logan. Dept. of Civil and Environmental Engineering.
C. J. Duffy, and L. W. Gelhar.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1175-1184, August 1985. 9 fig, 27 ref, NSF Grant No. CEE-8307982.

Descriptors: *Groundwater, *Path of pollutants, *Water quality, *Tracers, *Stochastic process, *Models, Solute transport, Frequency analysis, Mathematical models, Mathematical studies, Stochastic hydrology, Filters, Convection, Time series analysis.

A method for the analysis of complex temporal variations of environmental tracers or pollution time series in groundwater is examined using spectral analysis and linear filter theory for stationary stochastic processes. The interpretation of solute fluctuations subject to a time varying sources is accomplished via frequency domain solutions to stochastic differential equations for three widely applied transport models: a lumped parameter or linear reservoir model; convective (advective) transport in a curvilinear flow field; and convective-dispersive transport in a uniform flow field. Frequency domain solutions are presented in terms of the theoretical transfer function and phase spectra which describe the amplitude attenuation and phase lag between frequencies in the input and output. A comparison of the frequency response of the three models indicates that the unique filtering characteristics of each may provide a diagnostic tool for matching the appropriate theory to a sampled water quality 'signal'. A procedure is suggested for parameter estimation which involves comparison of hte theoretical and field estimated transfer function and phase spectra. (Author's abstract)
W86-04315

CLOSTRIDIUM PERFRINGENS, A RELIABLE INDICATOR OF STREAM WATER QUALITY,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
For primary bibliographic entry see Field 5G.
W86-04328

OPTIMAL DISCHARGE PROFILES FOR SUDDEN CONTAMINANT RELEASES IN STEADY UNIFORM OPEN-CHANNEL FLOW,
For primary bibliographic entry see Field 5E.
W86-04344

CHEMISTRY AND TRANSPORT OF SOLUBLE HUMIC SUBSTANCES IN FORESTED WATERSHEDS OF THE ADIRONDACK PARK, NEW YORK,
Maine Univ. at Orono. Dept. of Botany and Plant Pathology.
C. S. Cronan, and G. R. Aiken.
Geochimica et Cosmochimica Acta, Vol. 49, No. 8, p 1697-1705, August 1985. 6 fig, 3 tab, 26 ref. EPRI Contract RP1109.

Descriptors: *Path of pollutants, *Humic acids, *Adirondack Park, *New York, *Forest watersheds, Integrated Lake-Watershed Acidification Study, Interstitial water, Dissolved organic carbon, Leaching, Soil chemistry, Mixed forests, Natural water.

Studies were conducted in conjunction with the Integrated Lake-Watershed Acidification Study (ILWAS) to examine the chemistry and leaching patterns of soluble humic substances in forested watersheds of the Adirondack region. During the summer growing season, mean dissolved organic carbon (DOC) concentrations in the ILWAS watersheds ranged from 21-32 mg C/l in O/A horizon leachates, from 5-7 mg C/l in B horizon leachates, from 2-4 mg C/l in groundwater solutions, from 6-8 mg C/l in first order streams, from 3-8 mg C/l in lake inlets, and from 2-7 mg C/l in lake outlets. During the winter, mean DOC concentrations dropped significantly in the upper soil profile. Soil solutions from mixed and coniferous stands contained as much as twice the DOC concentration of lysimeter samples from hardwood stands. Results of DOC fractionation analysis showed that hydrophobic and hydrophilic acids dominate the organic solute composition of natural waters in these watersheds. Charge balance and titration results indicated that the general acid-base characteristics of the dissolved humic mixture in these natural waters can be accounted for by a model organic acid having an average pK sub a of 3.85, and average charge density of 4-5 microequivalents/mg C at ambient pH, and a total of 6-7 meq COOH per gram carbon. (Author's abstract)
W86-04347

TRACE METAL DEPOSITION AND MOBILITY IN THE SEDIMENTS OF TWO LAKES NEAR SUDBURY, ONTARIO,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
R. Carignan, and J. O. Nriagu.
Geochimica et Cosmochimica Acta GCACAK, Vol. 49, No. 8, p 1753-1764, August 1985. 3 fig, 4 tab, 31 ref.

Descriptors: *Trace metals, *Deposition, *Path of pollutants, *Lakes, *Sudbury, *Ontario, Diffusion, Clearwater Lake, McFarlane Lake, Iron, Manganese, Aluminum, Copper, Nickel, Lead, Hydrogen ion concentration, Water pollution sources.

The accumulation and mobility of Fe, Mn, Al, Cu, Ni and Pb in the sediments of two lakes (Clearwater, pH 4.5; and McFarlane, pH 7.5) near Sudbury, Ontario have been investigated. The Al, Cu and Ni concentrations are expectedly relatively high in the overlying waters of Clearwater Lake and much lower for Al and Cu in McFarlane Lake. The low trace metal concentrations found in the anoxic porewaters of Clearwater Lake could be explained by a sharp increase in porewater pH concomitant with SO4(2-) reduction and H2S production within the first 1-2 cm of the sediments, which has conceivably led to the precipitation of mineral phases such as AL(OH)3, NiS, and CuS. In both lakes, Fe concentrations in anoxic porewaters appear to be controlled by FeS and/or FeCO3 formation. It is suggested that upwardly decreasing total Mn profiles resulting from the removal of Mn from the top sediment layers under acidic conditions may constitute a reliable symptom of recent lake acidification. The downward diffusion of Al, Cu and Ni from the overlying water to the sediments has been estimated from their concentration gradients at the interface and compared to their total accumulation rates in the sediments. In both lakes the diffusion of Al is negligible compared to its accumulation rate. However, diffusion accounts for 24-52% of the accumulation of Cu in the sediments of Clearwater Lake, but appears negligible in McFarlane Lake.

The downward diffusive flux of Ni is important and may explain appears negligible in McFarlane Lake. The downward diffusive flux of Ni is important and may explain 76-161% of the estimated Ni accumulation rate in Clearwater Lake, and 59% in McFarlane Lake. The porewater Cu and Ni profiles suggest that the subsurface sedimentary trace metal peaks observed in Clearwater Lake (as in other acid lakes) may not be caused by sediment leaching or by a recent reduction in sedimentation but may have a diagenetic origin instead. (Author's abstract)
W86-04349

SOLUTE ACQUISITION IN GLACIAL MELT WATERS. I. FJALLSJOKULL (SOUTH-EAST ICELAND): BULK MELT WATERS WITH CLOSED-SYSTEM CHARACTERISTICS,
University of East Anglia, Norwich (England). School of Environmental Sciences.
For primary bibliographic entry see Field 2C.
W86-04351

MODEL FOR POLLUTANT CONCENTRATIONS DURING SNOW-MELT,
Nottingham Univ. (England). Dept. of Theoretical Mechanics.
S. Hibberd.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 58-65, 1984. 7 fig, 17 ref.

Descriptors: *Model studies, *Path of pollutants, *Melt water, *Pollution load, Rivers, Lakes, Unsaturated flow, Snow pack, Percolation, Hydrodynamics, Saturated flow.

In recent years extensive measurements of pollutant concentrations within the environment have been made over western Europe following reports of unusually high pollution levels within rivers and lakes, especially after the start of the spring melting period. A simple model is presented to describe, theoretically, the pollutant efflux within the first fractions of melt water released from a snow-pack at the start of the melting season. The dominant features included are the appearance of a wave-front as heading the unsaturated flow of melt water and the pollutant dispersion arising from the interaction of the flow with the porous structure of the snow-pack and molecular diffusion. Results of the snow-melt model appear to be in agreement with the available experimental studies, however two aspects require further comment. First the percolation of melt water is not a homogeneous process; melt water often follows preferred channels through the snow-pack rather than percolating downwards as a uniform front of water. Such inhomogeneities will cause pollutant and melt water to penetrate the snow-pack more quickly within the preferred channels, resulting in an earlier and less abrupt start to the melt-water run-off. The second aspect concerns the value for the coefficient of hydrodynamic dispersion. Theories for hydrodynamic dispersion are well proven for the saturated flow of liquids through porous media, but many results for unsaturated flow must be obtained by direct inference from the corresponding results for the saturated flow. Correspondingly the prediction for the dispersion coefficient may need modification when used for the highly unsaturated flow conditions typical within a melting snow-pack. (Lantz-PTT)
W86-04354

FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS, II,
Henkel K.G.a.A., Duesseldorf (Germany, F.R.). Dept. of Ecology.
P. Wierich.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 290-294, December 1985. 1 ref, append.

Descriptors: *Activated sludge process, *Mathematical models, *Adsorbents, Dry matter, Sludge, Mathematical analysis, Solubility.

An inhomogeneous first-order differential equation allows description of the time-dependent concentration change of an adsorbing compound in an activated sludge plant. Besides those parameters formerly considered (i.e., adsorption constant and surplus sludge wastage rate) the difference in dry matter content of the wasted sludge and that remaining in the activated sludge stage are now taken into account as well. This facilitates a more exact calculation of the elimination. The essential advantage of the new model lies in its simpler and faster applicability. The equations are steady, and can be integrated facilitating activities such as the calculation of the mean retention time of the adsorbed material in the activated sludge stage. Other mechanisms such as biodegradation, precipitation, flocculation, and stripping are, as in the older model, not taken into account. (Author's abstract)
W86-04356

CMA: AN ALTERNATIVE TO ROAD SALT,
Defense Environmental Leadership Project, Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04359

CHLOROFORM IN TAP WATER AND HUMAN BLOOD,
Turku Univ. (Finland). Dept. of Public Health.
For primary bibliographic entry see Field 5F.
W86-04361

ACCUMULATION OF SEDIMENT-BOUND PCBS BY FIDDLER CRABS,
Environmental Research Lab., Gulf Breeze, FL.
J. R. Clark, J. M. Patrick, Jr, J. C. Moore, and J. Forester.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 571-578, April 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Polychlorinated biphenyls, *Bioaccumulation, *Fiddler crabs, *Sediments, *Uptake, *Depuration, New York harbor, Pilot study, Toxicity, Food webs.

Rates of polychlorinated biphenyl (PCB) uptake and depuration were determined in a simulated spoil bank habitat that contained PCBs in weathered sediment (New York Harbor sediments). In a pilot study, the rates were compared in Uca pugilator, an inhabitant of relatively dry and sandy areas and U. minax, which inhabits wetter and muddier substrates. Mortality for U. miniax ranged from 2-14% over the contaminated substrate treatment and 6-10% over the controls; for U. pugilator mortality ranged from 2-8% on contaminated substrates and 1-4% for controls. Mortality was attributed to cannibalism upon molting rather than toxic effects. Because of the variability of PCB concentrations within crab populations, little significance can be attributed to higher bioaccumulation factor (BAF) values calculated for U. minax compared to U. pugilator, especially in light of test results showing that the BAFs for the two species were similar in two series of experiments. Fiddler carabs have the potential to accumulate PCBs rapidly from contaminated sediments and to develop body burdens similar to concentrations in sediment. Contaminated sediments must be taken into account when evaluating environmental exposures to PCBs because other animals feed on fiddler crabs, possibly resulting in bioaccumulation of PCBs in food webs. (Rochester-PTT)
W86-04365

HEAVY METALS IN OYSTER TISSUE AROUND THREE COASTAL MARINAS,
South Carolina State Dept. of Health and Environmental Control, Columbia.
J. M. Marcus, and A. M. Thompson.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 587-594, April 1986. 1 fig, 5 tab, 11 ref.

Descriptors: *Oysters, *South Carolina, *Coastal pollution, *Monitoring, *Bioindicators, *Marinas, Cadmium, Chromium, Copper, Lead, Nickel, Zinc, Heavy metals, Condition index, Correlation coefficient.

The content of heavy metals was determined in tissue of the American oyster, Crassostrea virginica, collected at three marinas in coastal South Carolina. Mercury was not detected at any time at any station; Cd, Cu and Zn were measured in tissue from every station, whereas Pb and Ni were found at all but a few stations. Chromium was rarely detected. Total mean metal contents of tissue increased between spring and summer sampling periods. In most cases, there was a negative correlation between metal concentration and condition index (CI), indicating that the increases in metals concentrations between sampling periods were related to a loss of oyster body weight. Metals were preferentially partitioned to the gills and mantle. Strong positive correlations were between Cu and Cd at two of the three marinas and between Zn and Cd and Zn and Cu at all three marinas activities were limited essentially to shellstock from very near the marinas. (Rochester-PTT)
W86-04367

FENITROTHION AND AMINOCARB RESIDUES IN WATER AND BALSAM FIR FOLIAGE FOLLOWING SPRUCE BUDWORM SPRAYING PROGRAMS IN QUEBEC, 1979 TO 1982,
Quebec Ministere de l'Energie et des Ressources.
R. Morin, G. Gaboury, and G. Mamarbachi.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 622-628, April 1986. 1 tab, 23 ref.

Descriptors: *Fenitrothion, *Aminocarb, *Balsam Fir, *Spruce trees, *Insecticides, Spraying, Monitoring, Sumithion, Matacil, Aircraft, Quebec, Canada, Insect control, Forests.

Insecticide concentrations in the environment were determined in an area receiving annual spraying of Sumithion (fenitrothion) at 210 g active ingredient/hectare and Matcil 180D (aminocarb) at 52 g active ingredient/hectare in diesel oil diluent. Concentrations of fenitrothion and aminocarb in water and foliage showed very high variations among samples, with low concentrations in most and very high residue concentrations in some. Over the 4 yr studied, median residue levels were 3.81 micron g/g (dry weight) of fenitrothion and 0.94 micron g/g of aminocarb in balsam fir foliage, with maximum concentrations of 111 and 37.3 micron g/g, respectively. In lentic water, median residue levels were 5.82 micron g/l of fenitrothin and 0.74 micron g/l of aminocarb, with maximum levels of 1,114 and 331 micron g/l, respectively. In lotic water, median concentrations were 2.84 micron g/l of fenitrothion and 0.86 micro g/l of aminocarb, with maximum levels of 127 and 18.4 micro g/l, respectively. These reported insecticide levels were obtained 1-4 hr after spraying at a time when concentrations would be expected to peak. Data on residual concentrations of these insecticides suggests that the contamination of water by forest spraying presents few risks to fish and aquatic invertebrate populations. (Rochester-PTT)
W86-04368

OIL POLLUTION OF A GROUNDWATER SOURCE,
Eastbourne Waterworks Co. (England).
A. J. L. Clark.
Institute of Water Engineers and Scientists Journals JIWSDI, Vol. 40, No. 1, p 17-28, February 1986. 5 fig, 7 ref, 2 append.

Descriptors: *Oil pollution, *Groundwater, *Wells, Divers, Fluorimetry, Monitoring, England, Complaints, Costs.

The general characteristics of the Eastbourne Waterworks Company, East Sussex, England, are described and two incidents of oil pollution of groundwater sources are recounted, with information on investigations, remedial measures taken, costs of the incident, and seeking compensation for expenses. Incidents consisted of two occasions of consumer complaints about oily taste in the water. Immediately after each incident, the level of oil present in the water was estimated to be about 0.02

mg/l. Remedial and securing activities consisted of (1) a survey of the adit system by divers, (2) sealing of trial bores made along the line after the first incident, including pumping and sealing of these bores, and (3) sealing the adit system feeding from the suspected contamination source. These measures successfully stopped the oil contamination in the water system. A fluorimeter was obtained and installed in a continuously operating mode with an alarm to detect any future leakage of oil into the system from this source. (Rochester-PTT)
W86-04377

STUDY OF THE TRACE ORGANICS PROFILES OF RAW AND POTABLE WATER SYSTEMS,
Anglian Water Authority, Cambridge (England).
For primary bibliographic entry see Field 5F.
W86-04382

VOLATILE ORGANIC COMPOUNDS AT HAZARDOUS WASTE SITES AND A SANITARY LANDFILL IN NEW JERSEY,
New Jersey Inst. of Tech., Newark.
J. LaRegina, J. W. Bozzelli, R. Harkov, and S. Gianti.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 18-27, February 1986. 9 fig, 7 tab, 14 ref.

Descriptors: *Volatile organic compounds, *Hazardous waste sites, *Adsorbent, *Landfill, *Air pollution, Urban environment, Rural environment, Gas chromatography, Mass spectroscopy, New Jersey, Leachates, Vents.

Data were collected on ambient levels of volatile organic compounds (VOC: primarily chlorinated and aromatic) in and around six sites in New Jersey. Five sites were hazardous waste sites currently on the National Priorities List and were located in rural areas; one site was a landfill presently receiving non-hazardous municipal waste and situated in a more urban location. It is clear that VOC levels at hazardous sites and landfills vary greatly from site to site and at locations within each site. However, the overall levels were higher than typically found in urban environments for some VOCs, and it seems likely that the high levels are due ot the sites themselves. At one site, for example, average levels of toluene were on the order of 10 times that normally found at urban locations. The effects of the site characteristics and meteorological events on the level of VOCs at in the ambient air at these sites were not very clear. Although some samples did show higher levels of some VOCs near leachate pools or vents, no real trends were evident. Finally, problems were found with quality assurance with Tenax GC adsorbent used in the present study; these must be controlled with rigorous cleaning and maintenance procedures and perhaps more studies into the pore effects involved. (Rochester-PTT)
W86-04384

DISSOLVED AND SUSPENDED MATTER TRANSPORTED BY THE GIROU RIVER (FRANCE): MECHANICAL AND CHEMICAL EROSION RATES IN A CALCAREOUS MOLASSE BASIN,
Centre National de la Recherche Scientifique, Strasbourg (France). Centre de Sedimentologie et de Geochimie de la Surface.
For primary bibliographic entry see Field 2J.
W86-04387

ANALYSE THE HYDROCARBONS IN LIQUID REFINERY WASTES,
Bayerische Landesanstalt fuer Wasserforschung, Munich (Germany, F.R.).
For primary bibliographic entry see Field 5A.
W86-04388

HEALTH RISK COMPARISON BETWEEN GROUNDWATER TRANSPORT MODELS AND FIELD DATA,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
S. T. Hwang.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 66-70, February 1986. 2 fig, 2 tab, 19 ref.

Descriptors: *Risks, *Mathematical models, *Monitoring, *Waste disposal, *Groundwater movement, Carcinogens, Noncarcinogens, Model validation, Dispersion, Simulation.

Techniques of performing assessments of health risks from intake of groundwater impacted by waste disposal facilities are presented. The assessment consists of using monitored plume data, fate and transport modeling, or a combination of both approaches, and of using health effect data for carcinogens and noncarcinogens for health risk assessment. Examples of employment of the mathematical modeling approach at three sites and of the monitoring approach at five sites are presented, and the limitations of assessment methods are discussed. Despite uncertain parameters, particularly values for dispersivities, the fate and transport models are an important toll in supporting the health risk assessment that is based on monitoring data or conducted in the absence of such data. Though there are many analytical and numerical simulation techniques available at present, the reliability of such models cannot be adequately tested because of the inability to define the dispersion parameter for model validation. (Rochester-PTT)
W86-04397

EPIDEMIC CAMPYLOBACTERIOSIS ASSOCIATED WITH A COMMUNITY WATER SUPPLY,
Georgia Dept. of Human Resources, Atlanta.
For primary bibliographic entry see Field 5C.
W86-04403

METAL MOVEMENT IN SLUDGE-TREATED SOILS AFTER SIX YEARS OF SLUDGE ADDITION: 2. NICKEL, COBALT, IRON, MANGANESE, CHROMIUM, AND MERCURY,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
D. E. Williams, J. Vlamis, A. H. Pukite, and J. E. Corey.
Soil Science SOSCAK, Vol. 140, No. 2, p 120-125, August 1985. 4 fig, 2 tab, 10 ref.

Descriptors: *Heavy metals, *Land disposal, *Soil chemistry, *Sludge disposal, Sludge-treated soils, Path of pollutants, Nickel, Cobalt, Iron, Manganese, Chromium, Mercury, Loam, Oakland, California.

A study was conducted of the movement of the metals Ni, Co, Fe, Mn, Cr, and Hg in Dublin loam soil, after 6 years of sludge addition. Sludges from two sources were added annually at rates ranging from 0 to 225 metric tons/hectare (t/ha) in increments of 45 t. Increasing rates of sludge addition resulted in almost no change in the concentration of metals in the surface soil, with the exception of Cr and Hg, where the metal concentrations in the added sludge were markedly greater than those found in the untreated soil. In these cases, metal increased linearly with rate of sludge addition. Surface concentrations of HNO3-extracted Mn were less than those obtained at lower depths. The low values appeared to be due to the failure of HNO3 to extract all the Mn from sludge-treated soils. Only Fe, of all elements, increased significantly in the profile with time. No element moved more than 5 cm below the zone of sludge incorporation in either the highly acid (pH 4.5) Oakland or the near-neutral (pH 7.3) Pacheco sludge-treated soils. Relative metal availability followed the same order for both sludges, i.e., Mn > Co = Ni > Fe > Cr. Percentage of available metal in Oakland sludge-treated plots was nearly double that in Pacheco sludge-treated plots. Percentage availability of Fe and Cr was extremely low. (Lantz-PTT)
W86-04408

VARIATION IN THE QUALITY OF TENSION LYSIMETER SOIL WATER SAMPLES FROM A FINNISH FOREST SOIL,
Finnish Forest Research Inst., Helsinki.
For primary bibliographic entry see Field 2G.
W86-04410

FATE OF DI-2-(ETHYLHEXYL)PHTHALATE IN THREE SLUDGE-AMENDED NEW MEXICO SOILS,
B. C. Fairbanks, G. A. O'Connor, and S. E. Smith.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 479-483, October-December 1985. 3 fig, 2 tab, 19 ref. Contract No. DE-AC04-83AL21776.

Descriptors: *Fate of pollutants, *Path of pollutants, *Sludge, *Phthalates, *Soil Amendments, Organic compounds, Adsorption, Degradation.

The degradation, volatilization, and adsorption of Di-3-(ethylhexyl) phthalate (DEHP) were monitored in three calcareous soils from New Mexico amended or unamended with sewage sludge. Evolution of 14CO2 was the only mechanism of loss of DEPH from these soils. No volatilization of parent compound or organic metabolites was detected. The effects of sewage sludge on DEPH degradation varied with soil, DEPH concentration, and sludge incubation time. As a result, 50% disappearance time varied from 8 to 72 d, depending on treatment interactions. After 146 d, 76 to 93% of the DEHP-14C was evolved as CO2. DEHP persistence was reduced by previous exposure of the soil to sludge, but was increased or unaffected by fresh additions of sludge. Increasing DEHP concentration from 2 to 20 mg/kg soil increased DEHP persistence. Degradation of DEHP was greater in two sandy loams (Typic Haplargids and Petrocalcic Paleustolls) than in a clay soil (Typic torrifluvents). Preliminary data suggest extensive adsorption of DEPH by all soils with no effect of sewage sludge additions. (Author's abstract)
W86-04413

RESIDUAL CADMIUM FORMS IN ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
R. E. Feltz, and T. J. Logan.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 483-488, October-December 1985. 3 fig, 4 tab, 19 ref.

Descriptors: *Cadmium, *Anaerobic digestion, *Sludge, Speciation, Inorganic compounds, Metals, Extraction, Phosphates, Trace metals.

The effects of phosphorus and lime additions after acid extraction on residual Cd solubility and chemical forms in an anaerobically digested sewage sludge were investigated. High Cd content (11 mmol Cd/kg) anaerobically digested sewage sludge was aerated and then acidified to pH 2 to solubilize Cd. After 18 hr of acidification, the sludge was dewatered and the supernatant and solids separated. Seventy or more percent of the Cd was removed from the solids. Similar amounts of Ni, Mn and Zn were also removed, but Cu removal was only 26% and that of Pb was <5%. The acid extracted sludge was neutralized to pH 5.9 with Ca(OH)2. Before liming, the sludge was amended with rock phosphate (RP) or monocalcium phosphate (MCP). Solution Cd in the limed MCP sludge was 12% of that in the limed RP sludge or in the limed sludge without P addition. Chemical fractionation indicated that 50% of the Cd in the aerated unextracted sludge existed as inorganic precipitates with another 40% Na4P2O7 extractable (organically bound). Acidification solubilized 98% of the inorganic Cd and 86% of the organically bound Cd. Seventy-nine percent of the Cd remaining in the dewatered acidified sludge was in the KNO3 extractable (exchangeable) fraction. Liming redistributed the Cd with 13 to 19% as inorganic precipitates, 70 to 85% organically bound and <3% in the exchangeable fraction. Phosphate addition had no significant effect on Cd fractionation. (Author's abstract)
W86-04414

PLANT UPTAKE OF CADMIUM FROM ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.

T. J. Logan, and R. E. Feltz.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 495-500, October-December 1985. 6 fig, 17 ref.

Descriptors: *Cadmium, *Sludge, *Path of pollutants, *Plants, Soil analysis, Nitrogen, Trace metals, Absorption, Phosphorus, Vegetable crops, Extraction.

Approximately 80% of the Cd in an anaerobically digested sewage sludge (initially containing 11.6 mmol Cd/kg) was removed by acid extraction and dewatering. The acid extracted sludge was treated by (i) neutralization to pH 5.9 with Ca(OH)2, (ii) addition of monocalcium phosphate (MCP) followed by Ca(OH)2, neutralization to pH 5.9, and, (iii) addition of rock phosphate (RP) followed by Ca(OH)2 neutralization to pH 5.9. The three treated sludges and the non acid-extracted sludge (aerated prior to application to soil) were applied to Spinks loamy sand at rates equivalent to 18.7 and 37.4 micromol Cd/kg. Swiss chard (Beta vulgaris) was grown in the greenhouse for 56 d. Cadmium concentration in saturation extracts of the soil waith MCP sludge decreased below the detection limit of 1.8 x 10 to the minus 10th power mol/L by day 4 at the 37.4 micromol Cd/kg application rate, while Cd concentrations in saturation extracts of the other sludge treatments were much higher throuhgout the study. Chard yields were higher in the control than in any of the sludge treatments, and the difference was attributed to greater N availability in the control. Cadmium concentration in Swiss chard tissue at harvest was significantly lower from the MCP sludge than from the other sludges. Cadmium concentration in chard tissue was also higher from the aerated sludge (11.9 mmol Cd/kg) than from the three acid-extracted sludges (2.58-3.29 mmol Cd/kg). No significant difference in the Cd concentration of chard was obtained for the 18.7 and 37.4 micromol Cd/kg rates of the MCP sludge, while Cd concentrations in chard increased linearly with Cd applied by the other sludges. (Author's abstract)
W86-04415

DISTRIBUTION OF PLUTONIUM AND AMERICIUM BENEATH A 33-YR-OLD LIQUID WASTE DISPOSAL SITE,
Los Alamos National Lab., NM.
J. W. Nyhan, B. J. Drennon, W. V. Abeele, M. L. Wheeler, and W. D. Purtymun.
Journal of Environmental Quality, Vol. 14, No. 4, p 501-509, October-December 1985. 4 fig, 4 tab, 16 ref. Contract No. W-7405-Eng. 36.

Descriptors: *Toxic wastes, *Path of pollutants, *Landfills, *Waste dumps, *Plutonium, *Americium, *Radioactive waste disposal, Heavy metals, Water pollution sources, Radioactive wastes.

The distribution of Pu, 241Am, and water in Bandelier Tuff beneath a former liquid waste disposal site at Los Alamos was investigated. The waste use history of the site is described, as well as the previous field and laboratory studies of radionuclide migration performed at this site. One of the absorption beds studied had 20.5 m of water added to it in 1961 in an agressive attempt to change the distribution of radionuclides in the tuff beneath the bed. Plutonium and 241Am were detected to sampling depths of 30 m in this bed, but only found to depths of 6.5 to 13.41 m in an adjacent absorption bed (bed 2) not receiving additional water in 1961. After 17 yr of migration of the slug of water added to bed 1, 0.3 to 5.1% of the Pu inventory and 3.0 to 49.6% of the 241Am inventory was mobilized within the 30-m sampling depth, as less than one column volume of water moved through the tuff profile under the bed. The results of similar lab and field studies performed since 1953 were compared with our 1978 data and site hydrologic data was used as a time marker to estimate how fast radionuclide migration occurred in the tuff beneath absorption bed 1. Most of the radionuclide migration appeared to have occurred within 1 yr of the 20.5-m water leaching in 1961. The implications of our research results to nuclear waste management were also discussed. (Author's abstract)
W86-04416

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: I. A CASE STUDY,
Guelph Univ. (Ontario). Dept. of Soil Science.
M. H. Miller, J. B. Robinson, and R. W. Gillham.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 533-538, October-December 1985. 5 fig, 4 tab, 14 ref.

Descriptors: *Manure, *Ponds, *Surface sealing, *Infiltration, Feedlot wastes, Groundwater, Wastewater collection, Chlorides, Nitrates, Denitrification, Path of pollutants, Water pollution sources.

A monitoring system was established on an unlined, earthen storage pond near Kitchener, prior to the addition of liquid manure from a 4500-head beef (Bos taurus) feeding operation. The bottom of the pond, which had a surface area when full of 2 ha, was a coarse textured sand. This material, with some gravel layers, extended below the water table, which was initially at 13.7 m below the ground surface. A platform, at which soil moisture measurement and groundwater sampling tubes were installed, was constructed within the pond. Additional groundwater sampling tubes were installed at several points surrounding the pond. Moisture content of the soil immediately below the pond reached saturation when liquid manure was first added but began to decrease within 2 weeks and reached a steady state at a water potential of about -0.03 MPa within 90 days. The infiltration rate at this time was estimated to be <10 to the minus 8th power m/s, a value considered to indicate that the bottom was effectively sealed. There was a rapid increase in Cl content of the groundwater within 2 weeks of manure addition but the concentration declined to initial values within 12 weeks. The NO3-N content of groundwater below the pond decreased to non-detectable values very shortly after addition of manure but returned to background values within 12 weeks except in the upper portions of the groundwater. It is concluded that the NO3-N depression was due primarily to dentrification in the goundwater as it passed below the pond. It is concluded that, with some limitations, unlined earthen manure ponds are environmentally acceptable, even in sandy material. (Author's abstract)
W86-04417

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: II. RATE AND MECHANISM OF SEALING,
New Liskeard Coll. of Agricultural Technology (Ontario).
J. G. Rowsell, M. H. Miller, and P. H. Groenevelt.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 539-543, October-December 1985. 3 fig, 4 tab, 19 ref.

Descriptors: *Manure, *Ponds, *Surface sealing, *Infiltration, Feedlot wastes, Animal wastes, Soil porosity, Wastewater collection, Wastewater disposal, Path of pollutants, Water pollution sources.

A laboratory study was conducted to determine the degree and rate of sealing of the soil surface where liquid beef (Bos taurus) manure with solids content of 50 g/kg was infiltrated into cores of a sandy loam, a loam, and a clay soil under hydraulic heads of 1 and 5 m. The infiltration rate was expressed in the logarithmic form of the Kostiakov equation: log q = A + b log t where q = infiltration rate (m/s) and t = time (s). In this relation A represents the log of the initial infiltration rate (at 1.0 s) and b is the rate of change in rate with time and reached a value of 10 to the minus 8th power m/s or less within 30 days on all soils at 1-m hydraulic head. This rate indicates an essentially impermeable system. At a 5-m head the infiltration rate reached 10 to the minus 8th power m/s within 10 days on the clay soil but required periods > 30 days on the other two soils. A physical blocking of pores was the major mechanism of sealing. The rate of reduction of infiltration into the loam soil was similar for sterilized manure indicating that biological activity was not a factor. Infiltration of a salt solution having similar cationic constituents as the manure remained constant over time indicating that dispersion of soil particles was not a factor. These results indicate that a liquid manure storage pond will effectively self-seal even with sandy materials. (Author's abstract)
W86-04418

GROUNDWATER QUALITY CHANGES RESULTING FROM A SURFACE BROMIDE APPLICATION TO A PASTURE,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
L. B. Owens, R. W. van Keuren, and W. M. Edwards.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 543-548, October-December 1985. 5 fig, 2 tab, 17 ref.

Descriptors: *Path of pollutants, *Groundwater pollution, *Leaching, Infiltration, Bromides, Subsurface drainage, Solute transport, Pastures, Lysimeters, Groundwater movement.

Potassium bromide was applied at a rate of 168 kg Br(-)/ha to two 1.1-ha pasture watersheds in east-central Ohio to study the impacts on groundwater quality of a one-time application of a soluble constituent. The watersheds had well-drained residual silt loam soils and average slopes of 20%. A nearly impermeable clay layer under the watersheds created a perched aquifer from which groundwater samples could be taken at developed springs. Three monolith, grassed lysimeters having soil profiles similar to the watersheds also received the Br(-) treatment. The lysimeters, which were 8 m2 in surface area and had a depth of 2.4 m, had shorter leaching pathways than the watersheds and showed peak Br(-) concentrations in percolation (24.0 mg/L maximum peak) occurring 52-78 weeks following the Br(-) application. The Br(-) concentration in the groundwater from the watersheds had lower peaks (9.2 mg/L maximum peak) but occurred 84 to 104 weeks after the Br(-) application. Because of variable leaching pathway lengths, including pathways much longer than those in the lysimeters, the watershed groundwater Br(-) applications had shown no meaningful decrease by 2 yrs after the Br(-) application. It is concluded that a one-time application of a soluble, nondegradable chemical constituent can have a multi-year influence on groundwater quality. (Author's abstract)
W86-04419

EFFECT OF NITRILOTRIACETIC ACID ON THE SOLUBILITIES OF METALS IN SOIL-SLUDGE MIXTURES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5E.
W86-04420

PICLORAM MOVEMENT IN AN APPALACHIAN HARDWOOD FOREST WATERSHED,
Florida Univ., Gainesville. Dept. of Soil Science.
D. G. Neary, P. B. Bush, J. E. Douglass, and R. L. Todd.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 585-592, October-December 1985. 4 fig, 3 tab, 40 ref.

Descriptors: *Herbicides, *Path of pollutants, *Soil solution, Springs, Pesticides, Stream pollution, Forest watershed, Appalachian Mountains.

Picloram (4-amino-3,5,6-trichloropicolinic acid) was applied at a rate of 5.0 kg/ha acid equivalent to 4 ha of the 28-ha Watershed 19, Coweeta Hydrologic Laboratory in western North Carolina. The herbicide was broadcast manually as a pellet formulation (10% acid equivalent) in May 1978, to eliminate a poor-quality mixed oak overstory and rhododendron (Rhododendron maximum L.)-laurel (Kalmia latifolia L.) understory prior to planting white pine (Pinus strobus L.). Soil solution contained the highest picloram levels at 0.6 m (peak of 350 mg/cu m). Picloram residues were detected in soil solution 1.2 m into the soil, but concentrations were <25 mg/cu m, and persisted for only 60 weeks. Intensive sampling of two springs detected trace levels for a period of 18 days. Only sporadic, low level picloram residues

were detected in streamflow from nested 10-ha and 28-ha watersheds during a 70-week period. Use of the herbicide picloram did not affect the quality of streamflow from Watershed 19 for domestic or agricultural purposes within the two years of the study. (Peters - PTT)
W86-04421

TRACE ORGANIC COMPOUNDS IN RAIN. 4. IDENTITIES, CONCENTRATIONS, AND SCAVENGING MECHANISMS FOR PHENOLS IN URBAN AIR AND RAIN,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
C. Leuenberger, M. P. Ligocki, and J. F. Pankow.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1053-1058, November 1985. 5 tab, 39 ref. EPA Grant No. R8113380.

Descriptors: *Air pollution, *Fate of pollutants, *Rain, *Chemistry of precipitation, *Phenols, Hydrocarbons, Precipitation, Organic compounds, Trace levels, Urban areas, Pollutant identification, Industrial wastes, Portland, Oregon, Henry's law.

The gaseous and filterable air concentrations of a variety of phenols were determined for seven rain events in Portland, Oregon. The dissolved and filterable rain concentrations were also determined concurrently. The phenols in the air were found to exist virtually exclusively in the gaseous state as expected on the basis of their large vapor pressures. The fact that virtually all of the phenols found in the rain were present in the dissolved state is in agreement with the air data. The rain (dissolved) concentrations were quite high, in the microgram per liter range. Of all the constituents present in the rain samples, the most concentrated ones were phenols. The results indicate that gas scavenging is much more important than particle scavenging for phenols. Considering the rather low values of their Henry's law constants, gas scavenging is an efficient atmospheric removal process for these compounds. (Author's abstract))
W86-04422

TIME SCALES OF CATCHMENT ACIDIFICATION,
Virginia Univ., Charlottesville.
B. J. Cosby, G. M. Hornberger, J. N. Galloway, and R. F. Wright.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1144-1149, December 1985. 2 fig, 16 ref. NSF Grant No. CEE-8215914.

Descriptors: *Acid rain, *Sulfates, *Path of pollutants, *Acidification, *Water pollution effects, Atmospheric deposition, Water pollution sources, Soil chemistry.

A quantitative model that is used to estimate patterns and absolute time scales of surface water acidification is presented that is based on mathematical representations of those processes that are thought to be the primary catchment controls on acidification. The model which is based on the assumption that surface water chemistry is determined by reactions that occur in the soils and rocks within a catchment is called MAGIC (model of acidification of groundwater in catchments). In the present study in estimating time scales, a hypothetical catchment was used along with a simplified temporal sequence of atmospheric sulfur deposition to elicit the widest range of responses possible from the soil processes included in MAGIC. The MAGIC model expands the simple, two-component (Ca-Al) system of Reuss and Johnson to include other important ions in catchment soil and surface waters. The hypothetical catchment used in the study was designed to be sensitive, with low alkalinity prior to onset of acid deposition, yet relatively slow responding, with moderate sulfate adsorption capacity. Results of the model are divided into the stages of acidification. The present model is considered an effective tool for examining the implications of certain assumptions about the long-term processes that control the acidification and recovery of upland catchments. (Geiger - PTT)
W86-04423

DIFFUSION AND PARTITIONING OF HEXACHLOROBIPHENYL IN SEDIMENTS,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
D. M. DiToro, J. S. Jeris, and D. Ciarcia.
Environmental Science and Technology ESTHAG, Vol. 12, p 1169-1176, December 1985. 5 fig, 6 tab, 30 ref. EPA Grant No. R805229.

Descriptors: *Fate of pollutants, *Hexachlorobiphenyls, *Diffusion coefficient, *Polychlorinated biphenyls, *Sediment-water interfaces, *Mathematical models, Organic compounds, Marine sediments, Path of pollutants, Sediments, Interstitial water, Sorption, Adsorption, Mathematical studies, Hydrophobic compounds, Saginaw Bay.

The fate of persistent hydrophobic chemicals in natural bodies of water is greatly affected by the transport mechanisms between sediments and the overlying water: particle transport and interstitial water diffusion. An experimental study was made of the interstitial water diffusion of hexachlorbiphenyl (HCBP) in undisturbed sediments taken from Saginaw Bay. The diffusion coefficient and partition coefficient of HCBP were determined by using a dual radio-tag experiment that extended over 2 yr. In general, constant coefficients were observed. An independent measurement of the diffusion coefficient for a nonsorbing chemical (tritiated water) allows an estimate to be made of the interstitial water-sediment partition coefficient. The results were in close agreement with those predicted from hydrophobic sorption correlations based upon sediment organic carbon and HCBP octanol-water partition coefficients. The results also correspond to the low particle concentration limit of the partition coefficients found when batch equilibrations of dilute suspensions of the same sediment were used. (Geiger - PTT)
W86-04424

LEAD CYCLING IN AN ACIDIC ADIRONDACK LAKE,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
For primary bibliographic entry see Field 2K.
W86-04425

RAPID CONSUMPTION OF BROMINE OXIDANTS IN RIVER AND ESTUARINE WATERS,
Maryland Univ., College Park. Dept. of Chemistry.
D. A. Jaworske, and G. R. Helz.
Environmental Science and Technology, Vol. 19, No. 12, p 1188-1191, December 1985. 6 fig, 2 tab, 27 ref.

Descriptors: *Bromine, *Seawater, *Fate of pollutants, *Electrochemistry, *Oxidation-reduction potential, *Estuaries, *Rivers, Chlorine, Ozone, Chemical reactions, Oxidation process, Oxidation, Organic matter, Humic acid, Decomposition, Halogens, Patuxent River, Maryland, Photolysis.

Fluvial and estuarine waters possess a substantial reductive capacity that rapidly destroys strong oxidants introduced from natural or anthropogenic sources. The rapid reduction of bromine oxidants, which in marine waters are intermediates in the decomposition of both chlorine and ozone, has been studied electrochemically in the field and the laboratory with a rotating ring disk electrode. Patuxent extuary water was found to contain about .00001 M of substances that reacted extremely rapidly with bromine. Estimated second-order rate constants were on the order of 10 to the 7th power /M/sec or higher. Bromine consumption did not correlate with salinity, nor was it altered by addition of .0001 M ethylenediaminetetrasacetic acid or by ultrafiltration. However, destruction of organic matter by UV photolysis eliminated bromine consumption on the .02/sec time scale of the experiments. Likewise, the bromine-consuming components could be titrated away with HOBr, indicating that they are not catalysts. Commercially available humic acid behaved qualitatively in a similar fashion to the natural reductants. (Author's abstract)
W86-04426

INTERFERENCE IN THE BACTERICIDAL PROPERTIES OF INORGANIC CHLORAMINES BY ORGANIC NITROGEN COMPOUNDS,
California Univ., Irvine. Program in Social Ecology.
R. L. Wolfe, N. R. Ward, and B. H. Olson.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1192-1195, December 1985. 1 fig, 4 tab, 18 ref. Grant No. MUD 1373.

Descriptors: *Fate of pollutants, *Chloramines, *Disinfectants, *Organic compounds, *Nitrogen compounds, *Bactericides, Disinfection, Reservoirs, Water treatment, Bacteria, Ammonia, Water quality, Water quality control, Water quality, Management, Amino acids, Glycine, Chloramines.

The interference of nitrogenous organic compounds on the bactericidal activity of chloramines was examined. The amino acid glycine (0.1-0.5 milligrams/liter as nitrogen) was supplemented into water samples obtained from a finished water reservoir to artificially increase the levels of organic nitrogen. Inactivation rates of total count bacteria were markedly slower with chloramines (1.6 milligrams/liter; C12-N, 3:1 w/w; pH 8) when preammoniation and concurrent application methods were compared to preformed chloramines. Levels of glycine as low as 0.1 milligrams (as nitrogen)/liter reduced the bactericidal activity with the preammoniation procedure. No decrease in the bactericidal properties was observed when preformed chloramines were assayed in the presence of glycine. Significantly, the inorganic chloramine residuals (ammonia derived) and organic chloramine residuals (glycine derived) could not be distinguished by amperometric or ferrous ammonium sulfate-diethyl-p-phenylenediamine titration techniques. Hence, residual measurement by conventional analytical techniques may not indicate the true level of disinfection potential of chloramines. (Author's abstract)
W86-04427

DECOMPOSITION OF OZONE IN WATER IN THE PRESENCE OF ORGANIC SOLUTES ACTING AS PROMOTERS AND INHIBITORS OF RADICAL CHAIN REACTIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
J. Staehelin, and J. Hoigne.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1206-1213, December 1985. 9 fig, 2 tab, 40 ref.

Descriptors: *Ozone, *Decomposition, *Fate of pollutants, *Chemical reactions, *Organic compounds, Disinfectants, Water treatment, Drinking water, Humic acid, Sugars, Acids, Alcohols, Solutes.

The decomposition of aqueous ozone is generally due to a chain reaction involving OH radicals. Many organic solutes (impurities) can react with OH to yield O(2-) upon addition of 02. O(2-) transfers its electron to a further ozone molecule in a rather selective reaction. The ozonide anion O(3-) formed immediately decomposes into a further OH radical. Compounds that convert OH radicals into ozone-selective O(2-), therefore, act as promoters of the chain reaction. The efficiences of different OH to O(2-) converters (e.g., formic acid, primary and secondary alcohols (including sugars), glyoxylic acid, and humic acids) are tested in the presence of other OH radical scavengers that do not primarily produce O(2-) (carbonate, aliphatic alkyl compounds, and tert-butyl alcohol). The derived reaction kinetics allows one to qualitatively interpret the variation of the lifetime of O(3-) found in model solutions and even in natural waters and during drinking water treatment. (Author's abstract)
W86-04428

SURFACE CHARGE AND ADSORPTION PROPERTIES OF CHRYSOTILE ASBESTOS IN NATURAL WATERS,
California Inst. of Tech., Pasadena. Dept. of Envi-

ronmental Engineering Science.
R. C. Bales, and J. J. Morgan.
Environmental Science and Technology ESTHAG, Vol. 19, No. 12, p 1213-1219, December 1985. 11 fig, 27 ref.

Descriptors: *Asbestos, *Decomposition, *Natural waters, *Adsorption, *Model studies, Absorption, Ions, Organic matter, Fate of pollutants, Asbestos cement, Pipelines, Pipes, Models, Minerals, Weathering, Silica, Magnesium.

Changes in surface-charge adsorption properties of chrysotile asbestos aging in water were studied in a series of constant-pH laboratory experiments. Chrysotile freshly suspended in an inorganic electrolyte has a positive surface charge below pH 8.9. Charge reversal occurs within about 2 weeks due to more rapid dissolution of chrysotile's outer magnesium hydroxide surface relative to the underlying silica component of the mineral. The inorganic anions NO3(-), Cl(-), HCO3(-), and SO4(2-) did not absorb. A constant-capacitance model can be used to relate surface charge to adsorption of protons over the pH range 7-9. At natural organic matter (NOM) concentrations at or below those encountered in natural waters, the particles can absorb sufficient organic matter within 1 day to acquire a negative charge. Adsorption of NOM reached a maximum of .000030 milligrams of C/sq cm after 21 hr; catechol continued to adsorb over 5 days. (Author's abstract)
W86-04429

IMPLICATIONS OF A GRADIENT IN ACID AND ION DEPOSITION ACROSS THE NORTHERN GREAT LAKES STATES,
Environmental Research Lab.-Duluth, MN.
G. E. Glass, and O. L. Loucks.
Environmental Science and Technology ESTHAG, Vol. 20, No. 1, p 35-43, January 1986. 3 fig, 6 tab, 39 ref. Agreement Nos. CR809412 and CR809484.

Descriptors: *Acid rain, *Spatial distribution, *Deposition, *Fate of pollutants, *Chemistry of precipitation, Acidic water, Ions, Cations, Anions, Sulfates, Sulfur, Ammonia, Hydrogen ion concentration, Nitrates, Oxides, Minnesota, Wisconsin, Michigan.

Average precipitation pH, 1979-1982, declines from west to east from 5.3 to 4.3 along a cross section of sites in Minnesota, Wisconsin, and Michigan. This answers questions about the seasonal and geographic pattern of anthropogenic acid precursor emissions and reaction products (SO4(2-), NO3 (-), H(+), NH4(+)) that increase from west to east. Except for higher concentrations of Ca(2+) and Mg(2+) observed at one site in the cultivated area of southwestern Minnesota, the contribution of soil-related metal cations to the total ions in solution is small (17%) and relatively uniform across the region. Significant seasonal and geographic patterns patterns in precipitation chemistry and deposition values are observed. Close correspondence of the sums of strong acid anions with the sums of hydrogen and ammonium ions in precipitation is observed, indicating anthropogenic sources of sulfur and nitrogen oxides. Present atmospheric inputs show close chemical correspondence when precipitation chemistry values are compared to the resulting ionic composition of weakly buffered lakes in north central Wisconsin and northern Michigan. The wet deposition of total acidity in the middle and eastern part of the region is comparable to that of impacted sites in the Adirondacks and in regions of Scandinavia. (Author's abstract)
W86-04431

AROMATIC HYDROCARBONS IN NEW YORK BIGHT POLYCHAETES: ULTRAVIOLET FLUORESCENCE ANALYSES AND GAS CHROMATOGRAPHY/GAS CHROMATOGRAPHY-MASS SPECTROMETRY ANALYSES,
Woods Hole Oceanographic Institution, MA. Dept. of Chemistry.
J. W. Farrington, S. G. Wakehman, J. B. Livramento, B. W. Tripp, and J. M. Teal.
Environmental Science and Technology ESTHAG, Vol. 20, No. 1, p 69-72, January 1986. 4 fig, 2 tab, 20 ref. Contract No. DE-AC02-77EV04256. A007.

Descriptors: *Polychaetes, *Aromatic compounds, *Fate of pollutants, *Fluorometry, *Pollutant identification, Bioaccumulation, Gas chromatography, Mass spectrometry, Biological samples, Hydrocarbons, Petroleum products, Organic compounds, New York, Path of pollutants.

Polychaetes collected from New York Bight sediments near sewage sludge and harbor dredge spoil dumpsites contained a series of diaromatic tetracyclid hydrocarbons of apparent triterpenoid origin. Microbial processes in sewage sludge are a likely source of these compounds. These octahydrochrysenes were much more abundant in the polychaetes than were the fossil fuel and combustion-derived polycyclic aromatic hydrocarbons which were found in the sediments, presumably because they are more available for biological uptake. If the polychaetes had been analyzed only by the spectrofluorometric techniques often used for screening samples for petroleum contamination, then grossly inaccurate results for aromatic hydrocarbon content would have been obtained. Therefore, UV fluorescence must be used in a hierarchical approach, with more sophisticated procedures available to verify the petrogenic nature of the hydrocarbons. (Author's abstract).
W86-04432

PRODUCTS AND QUANTUM YIELDS FOR PHOTOLYSIS OF CHLOROAROMATICS IN WATER,
SRI International, Menlo Park, CA. Physical Organic Chemistry Dept.
D. Dulin, H. Drossman, and T. Mill.
Environmental Science and Technology ESTHAG, Vol. 20, No. 1, p 72-77, January 1986. 8 tab, 40 ref.

Descriptors: *Aromatic compounds, *Photolysis, *Fate of pollutants, *Decomposition, *Degradation products, Organic compounds, Oxidation, Degradation, Polychlorinated biphenyls, Hydrocarbons.

Photolysis of chlorobenzene, 2- and 4-chlorobiphenyl, and 2- and 4-chlorobiphenyl ethers in water with 250-300-nm light produce corresponding phenols or, in the case of 2-chlorobiphenyl ether, dibenzofuran exclusively. Quantum yields in most cases are very similar to those reported in hexane for the reduction process. 1,2,4-Trichlorobenzene and 2,3,7,8-tetrachlorodibenzodioxin (TCDD) photolyze much less efficiently in water than in hexane. A common pathway for photolysis of mono-chloroaromatics involving aryl cations accounts well for the experimental observations. C-O rather than C-Cl cleavage in TCDD may be a major pathway for its loss. Half-lives for photolysis of these chloroaromatics in sunlight in water range from 460 yr to 5 days; TCDD photolyzes in water with a half-life of about 4-5 days in summer at 4 deg latitude. (Author's abstract)
W86-04433

PCBS HAVE DECLINED MORE THAN DDT-GROUP RESIDUES IN ARCTIC RINGED SEALS (PHOCA HISPIDA) BETWEEN 1972 AND 1981,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
R. F. Addison, M. E. Zinck, and T. G. Smith.
Environmental Science and Technology, Vol. 20, No. 3, p 253-256, March 1986. 2 tab, 26 ref.

Descriptors: *Polychlorinated biphenyls, *DDT, *Arctic ringed seals, Path of pollutants, Water pollution effects, Tissue analysis, Air pollution, Metabolism, Arctic.

Mean DDT-group concentrations in the blubber of western Arctic ringed seals (Phoca hispida) sampled in 1981 were less than 1 microgram/g wet weight blubber, and mean PCB concentrations were less than 2 microgram/g wet weight. Male seals had higher concentrations than did females. In males, residue concentrations in blubber tend to increase with age, and a similar trend is seen in other marine mammals. This probably occurs because the males have no route other than slow metabolic degradation by which to excrete these compounds. In female seals, residue concentrations appear not to increase with age or at least not as sharply as in males. PCB concentrations were about half of those in a sample of the same population taken in 1972, when allowance was made for the variation of residue concentrations with age, sex and condition. This decline probably results from the ban on PCB manufacture and use imposed in the early 1970s. Concentrations of DDT-group residues did not show any clear decline over the same interval, and the relative proportions of p, p prime-DDT and p, p prime-DDE suggested that there is a continuing supply of DDT to the western Arctic. The most probable source of this is by atmospheric or water transport from the Far East, where DDT was used until at least the late 1970s. (Lantz-PTT)
W86-04440

FATE OF HAZARDOUS WASTE DERIVED ORGANIC COMPOUNDS IN LAKE ONTARIO,
Indiana Univ. at Bloomington. School of Public and Environmental Affairs.
R. Jaffe, and R. A. Hites.
Environmental Science and Technology, Vol. 20, No. 3, p 267-274, March 1986. 9 fig, 4 tab, 24 ref. EPA Grant R-808961.

Descriptors: *Fate of pollutants, *Hazardous wastes, *Organic compounds, *Lake Ontario, Path of pollutants, Water pollution, Distribution patterns, Gas chromatography, Mass spectrometry, Aromatic compounds, Niagara Falls, Fish.

Dated sediments cores from Lake Ontario's four sedimentation basins and sedentary fish from tributaries and embayments were analyzed by gas chromatographic, methane-enhanced, negative ion mass spectrometry for a group of fluorinated aromatic compounds. The historical record of these chemicals in Lake Ontario sediments agrees well with the use of the Hyde Park dump in the city of Niagara Falls, NY. These compounds first appeared in sediments in 1958 and rapidly increased until 1970. These dates coincide with the onset of dumping at Hyde Park and remedial action undertaken when this dump was closed, respectively. Chemicals leaking from this site are transported across the entire lake and accumulate in the three major sedimentation basins and in fish from the southern and eastern shores of the lake. Suspended sediment with its load of organic compounds enters the lake from the Niagara River and is swept along the southern nearshore zone by water currents. Sediment deposits temporarily all along this zone in a rather uniform distribution and, because water flow in this zone is rapid, this distribution takes place within a few months. From this point, mixing takes place in two ways. First, the sediment from the nearshore zone is mixed into the deep zones of the lake, probably by seasonal, thermal inversions of the water column. Second, the sediments in the deep zones are spread from basin to basin by mixing the layer of suspended sediment at the lake bottom. This transport mechanism distributes the pollutants in a relatively rapid and uniform way throughout the lake. The depositional record of a selected group of pollutants reflects the history of the Hyde Park dump's operation. (Lantz-PTT)
W86-04441

SNOW CHEMISTRY OF THE CASCADE-SIERRA NEVADA MOUNTAINS,
Geological Survey, Tacoma, WA. Water Resources Div.
L. B. Laird, H. E. Taylor, and V. C. Kennedy.
Environmental Science and Technology, Vol. 20, No. 3, p 275-290, March 1986. 11 fig, 7 tab, 47 ref.

Descriptors: *Atmospheric deposition, Acid rain, *Snow sampling, *Chemical manalysis, *Cascade Mountains, *Sierra Nevada Mountains, Hydrogen ion concentration, Sulfates, Nitrates, Water pollution effects, Path of pollutants, Washington, Oregon, California, Statistical analysis.

The assessment of geographic variations in atmospheric deposition in Washington, Oregon, and California using snow cores from the Cascade-Sierra Nevada Mountains, collected from late February to mid-March 1983, is presented. A statistical analysis of the analytical and sampling precision was made. The snowpack in the higher Cascades and Sierra Nevada is not strongly influenced by anthropogenic activities at present. The pH of snow samples ranges from 5.11 to 5.88. Sulfate and nitrate correlate with H(+) in some segments of the sample traverse. The SO4 data show apparent influence from major source areas in Washington and California; nitrate does not. An apparent decrease in NH4 in snow in Washington and California suggests atmospheric interactions resulting in the removal of NH4. The NH4 reduction raises questions about nutrient supply to the mountain vegetation. Heavy-metal correlations included Cd, Cu, and Fe with Pb, and Mn with K and DOC, among others. No correlation was found between constituents and snow-water content. (Lantz-PTT)
W86-04442

SOLUTION OF HYDROCARBONS IN A HYDROCARBON-WATER SYSTEM WITH CHANGING PHASE COMPOSITION DUE TO EVAPORATION,
Virginia Inst. of Marine Science, Gloucester Point.
D. R. Burris, and W. G. MacIntyre.
Environmental Science and Technology, Vol. 20, No. 3, p 296-299, March 1986. 4 fig, 1 tab, 12 ref. USAF Grant No. AFOSR-83-0036.

Descriptors: *Fate of pollutants, *Hydrocarbons, *Evaporation, *Oily water, *Phase composition, Oil-water interfaces, Path of pollutants, Oil spills, Methylcyclohexane, Ethylbenzene, Tetralin, 1-Methylnapthalene.

Several oil spill weathering studies have investigated the fate of spills in the aquatic environment. Weathering is a complex process that includes evaporation, dissolution, dispersion, advection, photochemical oxidation, and microbial degradation. Examination of the overall weathering process is further complicated by the complex composition of petroleum and difficulties in environmental sampling, but can be conducted in laboratories using water solubility vessels designed for use with both the single-component and four-component hydrocarbon mixtures of constant composition. Pure water was brought into contact with a four-component liquid hydrocarbon phase comprised of methylcyclohexane, ethylbenzene, tetralin, and 1-methylnaphthalene. The headspace above the hydrocarbon phase was continually purged with N2 to provide a controlled evaporative loss. Hydrocarbon concentrations in the water and hydrocarbon phases changed due to dissolution and evaporation and were measured as a function of time. A surface renewal mass transfer model is congruent with the observed hydrocarbon concentrations in the aqueous phase. Hydrocarbon-phase composition and component interactions are important in determining the time dependence of the aqueous-phase composition. The results have implications concerning the fate of components of petroleum products discharged in the aquatic environment. (Lantz-PTT)
W86-04443

DIAGENETIC TRACE-METAL PROFILES IN ARCTIC LAKE SEDIMENTS,
Alaska Univ., Fairbanks. Inst. of Marine Science.
J. C. Cornwell.
Environmental Science and Technology, Vol. 20, No. 3, p 299-302, March 1986. 1 fig, 36 ref.

Descriptors: *Trace metals, *Lake sediments, *Arctic, Manganese, Iron, Barium, Cobalt, Copper, Nickel, Zinc, Path of pollutants, Toolik Lake, Alaska.

The surfaces of hydrous Mn and Fe oxides are important sites for the removal of trace metals from natural waters. Selective extraction techniques show that trace metals on suspended particulates and in sediments are often associated with metal oxide phases. In Toolik Lake, AK, postdepositional migration of Mn and Fe within sediment results in Mn- and Fe-rich horizons. These arise from the reduction of Mn and Fe oxides, upward diffusion of Mn(2+) and Fe(2+), and precipitation of oxides closer to the sediment-water interface. The purpose of this study is to examine the effect of Mn and Fe migration on the distribution of trace metals (Ba, Co, Cu, Ni, and Zn) commonly found associated with lacustrine ferromanganese deposits. Heterogeneous trace-metal profiles have been found in the slowly accumulating sediments of Toolik Lake. Elevated Ba, Co, Cu, Mo, and Ni concentrations near the sediment-water interface are inconsistent with inputs from recent watershed disturbances. The apparent cause of trace-metal enrichment is comigration with Mn and Fe in pore water resulting in narrow bands of trace-metal enrichment associated with high (>15%) concentrations of Mn and Fe. The misinterpretation of diagenetic enrichments as anthropogenic features is a potential problem in mildly reducing, Mn- and Fe-rich lake sediments. (Lantz-PTT)
W86-04444

CHEMILUMINESCENCE VS. KJELDAHL DETERMINATION OF NITROGEN IN OIL SHALE RETORT WATERS AND ORGANONITROGEN COMPOUNDS,
California Univ., Berkeley. Lawrence Berkeley Lab.
For primary bibliographic entry see Field 5A.
W86-04445

COMPARISON OF ULTRAVIOLET AND REDUCTIVE AMPEROMETRIC DETECTION FOR DETERMINATION OF ETHYL AND METHYL PARATHION IN GREEN VEGETABLES AND SURFACE WATER USING HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY,
Middle Tennessee State Univ., Murfreesboro. Dept. of Chemistry and Physics.
For primary bibliographic entry see Field 5A.
W86-04446

INTERLABORATORY STUDY ON DETERMINATION OF POLYCHLORINATED BIPHENYLS IN ENVIRONMENTALLY CONTAMINATED SEDIMENTS,
Environmental Monitoring and Support Lab.-Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W86-04449

CHARACTERIZATION OF DYES IN ENVIRONMENTAL SAMPLES BY THERMOSPRAY HIGH-PERFORMANCE LIQUID CHROMATOGRAPHY/MASS SPECTROMETRY,
Research Triangle Inst., Research Triangle Park, NC. Analytical Sciences Div.
For primary bibliographic entry see Field 5A.
W86-04452

DEGRADATION OF THE TRI-N-BUTYLTIN SPECIES IN WATER AND SEDIMENT FROM TORONTO HARBOR,
Canada Centre for Inland Waters, Burlington (Ontario).
R. J. Maguire, and R. J. Tkacz.
Journal of Agricultural and Food Chemistry, Vol. 33, No. 5, p 947-953, September/October 1985. 3 fig, 6 tab, 32 ref.

Descriptors: *Degradation, *Tri-n-butyltin, *Path of pollutants, *Toronto Harbor, Water pollution, Sediments, Tin, Environmental effects, Water pollution effects, Toxicity, Light intensity, Thermal effects, Ontario.

The article discusses the adsorption of tri-n-butyltin species (Bu sub 3Sn(+)) to sediments and the degradation of Bu sub 3Sn(+) in water and sediment from Toronto Harbor, which is contaminated with butyltin species and inorganic tin. Contamination of water and sediment with Bu sub 3Sn(+) often produces its less toxic degradation products, the di-n-butyltin species (Bu sub2SN(2+)), n-butyltin species (BuSn(3+)), and inorganic tin. At some locations the concentration of Bu sub 3SN(+) in water is high enough to warrant concern with regard to chronic toxicity to sensitive organisms. The Bu sub 3Sn(+) species: (1) is bound fairly strongly to sterile Toronto Harbor sediment and the half-life of desorption is at least 10 months at 20 C, (2) can be taken up from sediment and degraded by oligochaetes, and (3) is degraded by a sequential debutylation pathway at 20 C in Toronto Harbor water and water-sediment mixtures with half-lives of 5 and 4 months, respectively. On the basis of this and earlier work, it is concluded that the main factors limiting the persistence of the tri-n-butyltin species in aquatic ecosystems are photolysis in water and biological degradation in water and sediment, and with the temperatures and sunlight intensities prevalent in Canada, the half-life is likely to be at least a few to several months. (Lantz-PTT)
W86-04454

DETERMINATION OF SELENIUM SPECIATION IN BIOGENIC PARTICLES AND SEDIMENTS,
Old Dominion Univ., Norfolk, VA. Dept. of Oceanography.
For primary bibliographic entry see Field 5A.
W86-04458

GEOPHYSICAL MONITORING OF GROUND WATER CONTAMINATION AROUND WASTE DISPOSAL SITES,
Waterloo Univ. (Ontario). Dept. of Earth Sciences.
J. P. Greenhouse, and M. Monier-Williams.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 63-69, Fall 1985. 7 6 ref.

Descriptors: *Groundwater pollution, *Monitoring, *Geophysics, Waste disposal sites, Seismic properties, Electrical studies, Electromagnetic studies, Conductivity, Landfills.

Geophysical techniques are widely used in evaluating potential sites for the disposal of waste. Seismic and electrical surveys are routinely undertaken to determine the nature and variability of geological and geotechnical parameters that influence the choice of a site. In the last decade, however, geophysics has assumed a further role. Electrical and electromagnetic methods are increasingly being used in the burgeoning activity of groundwater quality control around waste-disposal sites. These geophysical applications fall into two broad categories, here termed monitoring and mapping, both of which identify contaminated groundwater because of the enhanced electrical conductivity associated with abnormally high concentrations of dissolved solids. The potential and the problems for geophysical monitoring programs at waste disposal sites are discussed. No data are presented, but the expectations, design criteria and implementation of a geophysical monitor are examined for a hypothetical landfill. The authors conclude that any geophysical monitor must be designed to allow for future changes in the physical setting, geophysical technology and the personnel who will record, process and interpret the data. This suggests that permanent installations be kept to a minimum, and that a high priority be given to simplicity and reliability. It is also important that the detection limits of the monitor be clearly established, that the noise levels in readings unrelated to changes in contamination levels are well defined and that the monitor is integrated into an overall hydrogeological monitoring program. (Lantz-PTT)
W86-04473

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,
Geological Survey, Lawrence, KS. Water Resources Div.
For primary bibliographic entry see Field 7B.
W86-04474

BIOLOGICAL ACCUMULATION AND MONITORING OF CHEMICAL WASTES IN ARCTIC WATERS,

Solway Marine Investigations, Maryport (England).
E. J. Perkins.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 1-11, 1986.

Descriptors: *Biological monitoring, *Chemical wastes, *Arctic zones, Solway Firth, England, Toxicity, Fertility, Gastropods, Crustaceans, Polychaetes, *Bioaccumulation, Trace elements.

The biological accumulation and monitoring of chemical wastes are considered with particular reference to the Solway Firth, U.K. Monitoring of the influence of chemical wastes may be concerned with somatic or reproductive responses and is more usually the former. It is shown that size and abundance are not an indication of a species fertility which is crucial to its conservation. Diet has an important influence upon the magnitude of the trace element burden of gastropod molluscs and it is shown that the fertility of Patella vulgata and Littorina littorea is unaffected by marked increases in the trace element burden. In this study, some of the species examined such as, the polychaete worms Phyllodoce maculata and Scoloplos armiger, the decapod crustacean Pagurus bernhardus and the gastropod molluscs, Littorina littorea and Thais lapillus, have a distribution which extends into arctic waters. Clearly such animals offer the opportunity for comparative studies to test the more general application of the work reported. Such comparative work would also facilitate efforts to apply data from the boreal region to problems in the Arctic. (Author's abstract)
W86-04475

BEHAVIOUR AND FATE OF ARCTIC OIL SPILLS,
Environmental Protection Service, Ottawa (Ontario). Environmental Emergencies Technology Div.
A. M. Bobra, and M. F. Fingas.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 13-23, 1986. 2 fig, 4 tab, 8 ref.

Descriptors: *Path of pollutants, *Oil spills, *Arctic, *Cleanup operations, *Oil pollution, Fate of pollutants, Evaporation, Dispersants, Emulsifiers, Ice, Physicochemical properties, Distribution patterns, Beaufort Sea.

A brief overview is provided, based on several recent reports, of the dominant factors and processes which influence the behavior and physical fate of spilled crude oil in the remote harsh Arctic offshore regions. These factors and processes include physical-chemical properties, evaporation, dispersion, dissolution, emulsification, physical movement and interaction with ice. Rates of the individual dominant processes for a typical Beaufort oil in the Beaufort Sea under different physical environments are approximated and applied to various spill scenarios. Research needs in this field are summarized. (Author's abstract)
W86-04476

RANDOM TRANSPORT OF OIL BY SEA ICE,
Washington Univ., Seattle. Polar Science Center.
R. Colony.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 25-39, 1986. 9 fig, 13 ref. NOAA Contract No. 83-ABC-00358.

Descriptors: *Path of pollutants, *Random transport, *Oil spills, *Sea ice, Arctic, Mathematical models, Model studies, Markov Process, Prudhoe Bay, Peard Bay, Statistical analysis, Distribution patterns.

The transport of oil spilled upon the wintertime Arctic Ocean is modelled. As the motion of this oil is almost wholly due to its advection by sea ice, it is sufficient to study the motion of individual ice floes. The observational basis for our understanding of sea ice motion comes from the trajectories emanating from a potential site of spilled oil. This ensemble is modelled by a Markov process and is formulated in terms of the observed motion. Statistics of the modelled ensemble address the probability that an oil spill will be transported to an arbitrary region, perhaps an environmentally sensitive one. Results are shown for potential spills at Prudhoe Bay and Peard Bay. (Author's abstract)
W86-04477

OIL IN ICE COMPUTER SIMULATION MODEL,
Dome Petroleum Ltd., Calgary (Alberta).
P. D. Wotherspoon, and J. J. Swiss.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 41-46, 1986. 1 fig.

Descriptors: *Path of pollutants, *Fate of pollutants, *Oil spills, *Sea ice, *Simulation analysis, *Model studies, Mathematical models, Physicochemical properties, Distribution patterns, Beaufort Sea.

A computer simulation program which depicts the behavior and distribution of oil spilled in or under sea ice has been developed. The program combines mathematical models developed in previous studies to describe the motion of oil in/under landfast, first-year and multi-year ice. By inputting or estimating such key parameters as oil type, spill type, spill duration, flow rate, ice type, relative under ice current speed and direction, under ice roughness and distinct ice features, a time series of 'maps' is generated showing the distribution of the spilled oil. At present, the simulation does not include the movement of oil contaminated ice but future development plans include incorporation of the program into a Beaufort Sea ice motion model. The program is a tool which can be used to assist on-scene commanders during spill response and to plan counter-measures for oil spills in/under sea ice. (Author's abstract)
W86-04478

ACCUMULATION OF AIRBORNE TRACE POLLUTANTS BY ARCTIC PLANTS AND SOIL,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
W. Thomas.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 47-57, 1986. 3 fig, 6 tab, 21 ref.

Descriptors: *Air pollution, *Arctic, *Trace levels, *Vegetation, *Soils, Polyaromatic hydrocarbons, Heavy metals, Chlorinated pesticides, Benzohexachloride, Path of pollutants, Accumulation.

Plant and soil samples from 4 locations in Spitsbergen (Norway) were analyzed for major ions, heavy metals, polyaromatic hydrocarbons (PAH) and chlorinated pesticides. The results indicate that trace amounts of these substance groups result from a number of different sources, namely from subsoil material, local emissions and long range atmospheric transport. A comparison of inorganic and organic micropollutant concentrations allows a distinct between trace substance uptake from soil or air. (Author's abstract)
W86-04479

FATE OF PETROLEUM POLLUTANTS IN ARCTIC ECOSYSTEMS,
Louisville Univ., KY. Dept. of Biology.
R. M. Atlas.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 59-67, 1986. 2 fig, 1 tab, 77 ref.

Descriptors: *Fate of pollutants, *Oil pollution, *Arctic ecosystems, *Microbial degradation, Aquatic ecosystems, Biodegradation, Microorganisms, Nitrogen, Oxygen, Phosphorus, Oil spills.

Both experimental oil release field studies, in Arctic tundra, freshwater, and marine ecosystems, and follow-up studies after Arctic and subarctic oil spillage indicate long persistence times for hydrocarbon contaminants and slow rates of microbial biodegradation. The slow rates of petroleum biodegradation in Arctic ecosystems are not due to a lack of indigenous hydrocarbon-degrading microorganisms since virtually all Arctic ecosystems contain numbers of naturally occurring populations of hydrocarbon-degrading microorganisms, and generally numbers of hydrocarbons degraders increase following addition of oil. Low temperatures alone also can not explain the limited rates of hydrocarbon biodegradation. Rather the limitation to microbial degradation of petroleum hydrocarbons in Arctic ecosystems appears to be due to the combination of several factors, including the availability of nitrogen, phosphorus, and oxygen. Although the potential for hydrocarbon degradation exists, the actual rates of hydrocarbon biodegradation in Arctic ecosystems are slow; microbial hydrocarbon degradation can decontaminate Arctic ecosystems but the time frame after a major spillage will be decades rather than years. (Author's abstract)
W86-04480

ACID NEUTRALIZING CAPACITY OF GLACIAL SEDIMENTS IN WESTERN UNGAVA,
Montreal Univ. (Quebec). Dept. of Geology.
H. Wilson, M. A. Bouchard, and C. E. Delisle.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 69-85, 1986. 9 fig, 5 tab, 33 ref. NSERC Grant A8424.

Descriptors: *Acid neutralization, *Glacial sediments, *Acid rain, *Ungava, Ontario, Hydrogen ion concentration, Ecological effects, Carbonates, Silt, Clays.

The present research evaluates the sensitivity of the terrestrial and aquatic ecosystems to acid precipitation in western Ungava, Quebec. pH values of the acid-sediment mixtures were used to classify the sediments according to their capacity to neutralize acid. The carbonate and the silt and clay content of the sediments are considered as the main controlling factors of their neutralization properties. Average acid neutralizing capacity (ANC) values were calculated for 14 sites. pH values, determined from the neutralization characteristics at each site, were used to classify the sites on a pH scale, presumably a sensitivity scale. On this scale, the least sensitive site, with pH remaining above 7, is from the coast of Hudson Strait where the sediment is a clayey fossiliferous glaciomarine diamicton. Of higher but still relatively low sensitivity, with pH remaining above 4.5, are two sites below the Tyrrell Sea marine limit, where the sediments are predominantly shell-bearing raised littoral deposits. Of high sensitivity, with pH below 4.5, are the remaining sites either below or above marine limit. By comparison to pH values determined for samples collected further south, namely in the Chibougamau-Lac Mistassini region, in the Thetford Mines region, and in northeastern Ontario, the group of samples with pH remaining above 7 may be qualified as showing low sensitivity, those with pH between 7 and 4.5, of intermediate sensitivity, and finally those with pH below 4.5 of high sensitivity. It is concluded that ANC determinations can provide an adequate means of quantitative comparisons between widely separated regions and could possibly be used as one index of terrain sensitivity. Full assessment of terrestrial sensitivity to acid precipitation must also consider the hydrogeological characteristics at different localities. (Author's abstract)
W86-04481

COASTAL ECOLOGY AND THE ARCTIC OIL INDUSTRY: SOME ELEMENTS FOR FUTURE OIL-SPILL CONTINGENCY PLANNING,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5G.
W86-04482

ATMOSPHERIC ENVIRONMENT SERVICE LONG RANGE TRANSPORT OF AIR POLLUTANT ACTIVITIES IN THE TERRITORIES,
Atmospheric Environment Service, Edmonton (Alberta).
For primary bibliographic entry see Field 5A.
W86-04483

BACKGROUND LEVELS OF PETROLEUM RESIDUES IN THE CANADIAN ARCTIC MARINE ENVIRONMENT,
Bedford Inst. of Oceanography, Dartmouth (Nova

Scotia).
E. M. Levy.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 161-169, 1986. 1 fig, 3 tab, 21 ref.

Descriptors: *Baseline studies, *Canada, *Arctic, *Marine environment, Hydrocarbons, Petroleum residues, Surface microlayer, Bottom sediments.

The background levels of petroleum-related substances present as solid particulate material floating on the sea surface, as dissolved/dispersed residues in the sea surface microlayer and in the water column, and as substances in surficial bottom sediments have been measured throughout much of the Canadian arctic marine environment. The region is presently devoid of floating particulate petroleum residues, and the background levels of dissolved/dispersed petroleum residues are generally less than 30 micrograms/l in the surface microlayer and less than 0.5 micrograms/l in the water column. Concentrations of extractable residues are generally less than 5 micrograms/l in the sediments. In all cases, the existing background levels are well below those which have detrimental effects on living marine resources. (Author's abstract)
W86-04488

VARIABILITY OF PESTICIDE LOADS TO SURFACE WATERS,
New York State Coll. of Agriculture and Life Sciences, Ithaca. Dept. of Agricultural Engineering.
D. A. Haith.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1062-1067, November 1985. 4 fig, 5 tab, 20 refs.

Descriptors: *Path of pollutants, *Water pollution sources, *Farm runoff, *Monte Carlo simulation, *Hydrologic models, *Weather, *Atazine, *Carbofuran, Surface runoff, Frequency distribution, Insecticides, Herbicides, Atlanta, Georgia, Des Moines, Iowa.

The variability inherent in pesticide loads to surface water is considered and an efficient procedure for estimating mean and critical loads is presented. Pesticide loads to surface waters are essentially uncertain, but can be quantified in terms of probabilities by Monte Carlo simulation. The simulation process involves three model components: (1) a weather generator, which drives the second component with precipitation, temperature, and rainfall erosivity results, (2) a hydrology model, which yields runoff and sediment flow results, and (3) a soil chemical model, which produces estimates of pesticide runoff. To demonstrate the simulation procedure, pesticide runoff loads were estimated for hypothetical corn fields with 3% slopes and 91 m slope lengths near Atlanta, Georgia, and Des Moines, Iowa. Two commonly used pesticides were considered: carbofuran, an insecticide used for control of corn rootworm, and atrazine, an herbicide. Both pesticides were applied at 3,000 g/ha to the soil surface, on planting day each year, in the simulationmodel runs. Mean monthly and annual runoff loads are given by the model as percentages of the original 3,000 g/ha application rate. Monte Carlo simulation of pesticide runoff loads is not trivial. It requires mathematical models of weather, hydrology, and soil chemistry. Such models now are readily available, however, and their data needs can be met from available published sources. The models are easily programmed for small computers, making the simulation process a practical tool for water quality planners and engineers. (Rochester-PTT)
W86-04491

AIRBORNE MERCURY IN PRECIPITATION IN THE LAKE SUPERIOR REGION,
Environmental Research Lab.-Duluth, MN.
G. E. Glass, E. N. Leonard, W. H. Chan, and D. B. Orr.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 37-51, 1986. 3 fig, 6 tab, 3 ref. Grant No. CR809412.

Descriptors: *Air pollution, *Precipitation, *Chemistry of precipitation, *Mercury, *Lake Superior, Duluth, Minnesota, Ontario, Rain, Snow, Wisconsin, Michigan, Heavy metals, Acid rain.

Mercury was measured in accumulated snow (March 1982) sampled from around Lake Superior and in rainfall from Duluth, Minnesota, (June-September 1982 and March-November 1983). Forbes Township, and Dorset in northwestern and central Ontario, respectively (May-September 1983). Methods of melting snow and collecting rain samples were investigated to avoid loss of mercury during the melting process and sample shipment and storage. Low concentrations in snow and rain required greater analytical sensitivity. A detection limit of 0.008 + or - 0.004 micrograms/L of mercury (N = 26) was attained using the cold vapor technique; and by utilizing a gold gauze amalgam accessory for preconcentration, a detection limit of 0.005 + or - 0.003 migrogram/L (N = 13) was attained. Regional comparisons of mercury accumulation in the snow pack across the northern parts of Minnesota, Wisconsin, Michigan, and Ontario show highest values, 0.10 + or - 0.17 microgram/L Hg, in the Grand Rapids, Minnesota, area and lowest values in remote areas of Minnesota and Ontario. Rainfall concentrations of total mercury were substantially higher than snow accumulation and were mainly of inorganic forms (73%). The highest amounts of mercury were measured in rainfall at Duluth, Minnesota (3.4 micrograms/L) during June 1982 and at Forbes township, Ontario, (1.2 micrograms/L) during July 1983. Substantially lower concentrations were observed in the other months of 1982 and 1983. There is no unique association of the observed mercury concentration with the air parcel history. However, the single highest mercury concentration in rainfall observed at Duluth, Minnesota, occurred when the 850-mb air parcel back trajectory indicated upwind corridors to the N-NW and the highest concentration at Forbes Township, Ontario, was associated with an 850-mb trajectory from W-NW. Significant positive correlation coefficients (0.05) were obtained with other measured components in rain at Duluth, Minnesota, including S, B, Ca, Mg, Na, Fe, Mn, and Zn in 1983. Mercury concentrations in precipitation and in lake water for precipitation-dominated lakes are similar and indicate that atmospheric deposition can be the major source of mercury for some lakes in the Lake Superior region. (Author's abstract)
W86-04525

SEASONAL AND SPATIAL DISTRIBUTION OF BACTERIA, CHLOROPHYLL, AND NUTRIENTS IN NEARSHORE LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W86-04526

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN NON-MIGRATORY FISH FROM THE NIAGARA RIVER AREA AND TRIBUTARIES TO LAKE ONTARIO,
Indiana Univ. at Bloomington. Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-04527

MEASURED AND CREAMS-PREDICTED NITROGEN LOSSES FROM TOMATO AND CORN MANAGEMENT SYSTEMS,
Southeast Kansas Branch Experiment Station, Parsons.
D. W. Sweeney, A. B. Bottcher, K. L. Campbell, and D. A. Graetz.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 867-873, October 1985. 4 fig, 1 tab, 12 ref.

Descriptors: *Agricultural runoff, *Trickle irrigation, *Dentrification, *Sprinkler irrigation, *Soil types, *Sand, *Leaching, Seasonal variation, Mathematical Models, Simulation, Soil porosity, Permeability Coefficient, Cultivated lands.

Nitrogen runoff and leaching losses from two tomato and four corn field plots were compared to model predictions by CREAMS, a field-scale model for Chemicals, Runoff, and Erosion from Agricultural Management Systems. The tomato treatments included trickle irrigation and overhead sprinkler irrigation and different N treatments, and the corn treatments included multiple N applications, minimum tillage and 'conventional' tillage. Model predictions of N losses from tomato and corn treatments located on sandy soils often disagreed with measured values. Treatment influences and seasonal trends for N losses from corn treatments located on a higher clay content soil were more satisfactorily predicted by CREAMS. The simulation ability of CREAMS for predicting N leaching on deep sands probably needs to be improved. Sensitivity analyses indicated that annual nitrate-N leaching loss predictions were either minimally or not affected by changes in saturated hydraulic conductivity. Input estimations of the fraction of soil pore space filled at field capacity and soil organic matter were inversely related to annual nitrate-N leaching losses, whereas potential mineralizable N was directly related to annual N leaching losses. (Rochester-PTT)
W86-04538

GEOCHEMISTRY OF SUSPENDED PARTICULATE MATTER IN TWO NATURAL SEDIMENTATION BASINS OF THE RIVER RHINE,
Technische Hogeschool Delft (Netherlands). Dept. of Chemical Engineering and Chemistry.
D. Van de Meent, J. W. De Leeuw, P. A. Schenck, and W. Salomons.
Water Research WATRAG, Vol. 19, No. 11, p 1333-1340, 1985. 7 fig, 1 tab, 26 ref.

Descriptors: *Geochemistry, *Organic Matter, *Trace Metals, *Multivariate analysis, *Rhine River, *Downstream gradient, Polysaccharides, Proteins, Principal components analysis, Canonical correlation analysis, Meuse River, suspended solids, Sedimentation, Particulate matter.

Multivariate analysis procedures were employed to trace possible correlations between changes in the composition of particulate organics and changes in the ratios of trace metal contents of suspended matter present in two major sedimentation basins of the River Rhine. In both basins, seaward gradients were observed in the organic characteristics as well as the trace metal 'patterns.' These two phenomena are well correlated. It can be concluded that the correlations observed in both basins for the changes in organic characteristics and the changes in trace metal pattern result from the processes that cause both these changes, namely, sedimentation of river particles and autochthonous production of organic matter in a seaward direction for the Ketelmeer/Ijsselmeer basin and admixture of particulate matter of the rivers Meuse and Rhine and the resuspension of particulate matter for the Hollands Diep/Haringvliet basins. (Rochester-PTT)
W86-04547

SOURCES OF WATER TO THE SEAWATER WELL WHICH SUPPLIES THE FISH PONDS IN EILAT: IMPLICATIONS FOR FISHPOND MANAGEMENT,
National Mariculture Centre, Eilat (Israel).
M. D. Krom.
Water Research WATRAG, Vol. 20, No. 4, p 463-469, April 1986. 1 fig, 5 tab, 24 ref. BARD Research Grant No. I-626-83 and NCRD Grant No. AQ/13-157.

Descriptors: *Seawater wells, *Fish ponds, *Eilat, *Israel, *Water reuse, Water supply, Fish management, Aquaculture, Fisheries, Wastewater, Nutrients, Water management, Saline water.

The sources of water to the well supplying the fishponds in Eilat were determined using a simple mass balance approach, in which the concentration of various components in the source waters were measured and a series of simultaneous equations solved to determine the hydrological budget. It was calculated that 80% of the water supplied to the well was recycled pond water, 10% was seawater and 10% was sewage effluent. On the basis of major ion determinations, it was shown that there could be no significant contribution from natural groundwater. This method of water supply

has both disadvantages and benefits. The fishpond system was operated to produce gilthead seabream and gray mullet in the pond and oysters on the pond effluent. The major disadvantage was that the excess nutrients supplied in the inflow may have limited the total biomass of fish which could be grown in the ponds by making them more susceptible to mass mortalities due to both high oxygen or high ammonia/low oxygen concentrations. The benefits include the high productivity of diatoms due to the nutrients supplied which enabled there to be a successful oyster culture. In addition, 95-97% of the nitrogen supplied in the sources was as ammonium which is toxic to fish. After passage through the aerobic groundwater, 97% of the dissolved nitrogen was in the form of nitrate. At the same time, the coliform counts were reduced to undetectable levels. The major ion composition of the pond was enriched 25% relative to seawater because the evaporated seawater was replaced by sewage effluent. Despite this unusual ionic composition, fish, oysters and prawns were grown successfully in these ponds. (Author's abstract)
W86-04576

BIODEGRADATION PATHWAY OF O-CRESOL BY HETEROGENEOUS CULTURE: PHENOL ACCLIMATED ACTIVATED SLUDGE,
National Research Inst. for Pollution and Resources, Yatabe (Japan).
For primary bibliographic entry see Field 5D.
W86-04578

BIOLOGICAL HALF-LIVES OF EIGHT POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN RAINBOW TROUT (SALMO GAIRDNERD),
Canada Centre for Inland Waters, Burlington (Ontario).
For primary bibliographic entry see Field 5C.
W86-04582

INTEGRATED ANALYSIS OF ACIDIFICATION IN EUROPE,
National Board of Waters, Helsinki (Finland). Water Research Inst.
J. Alcamo, L. Hordijk, J. Kamari, P. Kauppi, and M. Posch.
Journal of Environmental Management JEVMA, Vol. 21, No. 1, p 47-61, July 1985. 12 fig, 1 tab, 8 ref.

Descriptors: *Acid rain, *Models, *Decision making, *Environmental impact statement, *Fate of pollutants, *Water pollution sources, Acidic water, Lakes, Sulfur, Water pollution prevention, *Water pollution control, Air pollution, Environmental effects, Acidity, Hydrogen ion concentration, Water pollution effects, Regional Acidification Information and Simulation, RAINS.

The interim status of the RAINS (Regional Acidification Information and Simulation) model designed to aid in decision making on acid rain control strategies in Europe is reviewed. RAINS consists of three linked compartments: pollutant generation, atmospheric processes, and environmental impact. Each of these compartments can be filled by four different submodels: sulfur emissions, EMEP sulfur transport, forest soil acidity, and lake acidity. The lake acidity submodel, which computes lake acidity levels as a function of catchment characteristics and local acid deposition contains four modules. The hydrological module routes precipitation into quickflow, baseflow and flow between soil layers. The soil chemistry module estimates the concentration of hydrogen ions in soil layers. The meteorological module transforms monthly sulfur deposition into acid stress to various sectors of the catchment. The lake response module calculates the concentration of hydrogen ions of the lake based on the ion loads. Model input of an energy pathway, a pollution control strategy, and an environmental impact indicator yields a scenario which is a consistent set of energy pathway, sulfur emissions, forest soil acidity and lake acidity. The RAINS model allows a user to quickly evaluate the consequences of many different alternatives to control acidification in Europe. (Geiger-PTT)
W86-04589

STREAM ACIDITY IN SOME AREAS OF WALES IN RELATION TO HISTORICAL TRENDS IN AFFORESTATION AND THE USAGE OF AGRICULTURAL LIMESTONE,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
S. J. Ormerod, and R.W. Edwards.
Journal of Environmental Management JEVMA, Vol. 20, No. 2, p 189-197, March 1985. 6 fig, 2 tab, 28 ref.

Descriptors: *Acidity, *Lime, *Acidic streams, *Reforestation, *Acid rain, *Wales, Hydrogen ion concentration, Acidic water, Agricultural runoff, Water pollution sources, Mineralization, Alkalinity, Limestone, Wye River.

Reported are recent patterns of pH and alkalinity in upland streams draining afforested and unafforested sub-catchments of the River Wye. Historical trends in afforestation, and in the use of agricultural limestone in Wales and elsewhere in the United Kingdom are also reviewed in relation to the possible influences these factors may have on surface water acidity caused by acid rain. Winter values of pH and alkalinity were significantly lower in 1983-1985 at four sites on soft water streams draining afforested catchments of the River Wye than at two sites on neighboring streams draining moorland. There was a decline in mean measured pH at all the sites between 1964-1970 and 1983-1985 which was more pronounced in afforested than in moorland streams. These findings are discussed in relation to historical patterns in afforestation and the use of agricultural limestone. Afforestation peaked in Wales, and on the study catchments, between 1950 and 1970. Lime usage in the United Kingdom had decreased by 46% by 1982; in Wales, a 55% decrease has occurred by 1970. Calculations indicate that agricultural liming could have a substantial effect on the mineral concentrations of soft water streams, although further experimentation is needed to substantiate these predictions. (Geiger-PTT)
W86-04600

MANAGEMENT OF OIL POLLUTION OF NATURAL RESOURSES IN NIGERIA,
Ibadan Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 5G.
W86-04601

COMMUNITY RESPONSES TO NON-POINT POLLUTION FROM AGRICULTURE,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
R. E. Rickson, and P. J. Stabler.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 281-293, April 1985. 4 tab, 42 ref.

Descriptors: *Nonpoint pollution sources, *Soil erosion, *Agricultural runoff, *Water pollution sources, *Social aspects, Public opinion, Attitudes, Erosion control, Environmental policy, Public policy, Education, Municipal water, Lakes.

Soil runoff from farms is a primary nonpoint source of urban water pollution and cooperation between farm and city residents is needed for the successful development and implementation of pollution control efforts. A critical point of analysis is whether rural and city people, when there is nonpoint pollution from farm erosion, respond on the basis of their self-interest or knowledge of the causes and consequences of pollution. Interviews of farmers and urban residents in an American midwestern state showed that farmers tended to blame city residents for lake pollution, although studies in the community revealed that lake pollution is mostly caused by farm soil loss. Levels of technically accurate knowledge had no direct association with either concern or allocation of blame. Education, as one indicator of knowledge, was associated with level of technical knowledge and concern, but not with how residents attributed blame. These data illustrate the dilemmas of regulating nonpoint water pollution from farm erosion. It was suggested that residential self-interest by farmers is related more to the constraints they face in controlling soil erosion, than to any inherently negative response to environmental quality and management. (Geiger-PTT)
W86-04605

VARIATIONS IN NITRATE CONCENTRATIONS AT AN IDAHO SITE DUE TO SEASONAL INFLUENCES,
South Central District Health Dept., Burley, ID.
J. Tolman.
Journal of Environmental Health JEVHAH, Vol. 48, No. 1, p 22-25, July/August 1985. 2 fig, 1 tab, 11 ref.

Descriptors: *Nitrates, *Drinking water, *Idaho, *Water pollution sources, *Groundwater pollution, *Seasonal variation, Aquifers, Wells, Irrigation water, Water supply, Sampling.

In fulfilling the requirements for sampling public water supplies in the state of Idaho, samples from one system were found to have high nitrate concentrations in both initial and check samples. A random sample by the purveyor seven months after the initial samples indicated lowered nitrate levels. To determine the yearly nitrate content of the supply and investigate the source or sources of the elevated levels, an investigation was initiated. Samples were collected between October 19, 1981 and September 27, 1982 from the subject well and twelve other wells in the general area. All samples were analyzed at certified laboratories. Results indicated considerable seasonal fluctuation in nitrates at the principal study location. Location of a drainfield in close proximity to the well and seasonal groundwater variations due primarily to irrigation and, to a lesser degree, to precipitation were probably responsible for the wide fluctuation of nitrate concentrations in the well water at the study site. (Author's abstract)
W86-04607

GROUNDWATER CONTAMINATION: A NATIONAL PROBLEM WITH IMPLICATIONS FOR STATE AND LOCAL ENVIRONMENTAL HEALTH PERSONNEL,
Winnebago County Dept. of Public Health, Rockford, IL.
J. M. Bacon, and W. A. Oleckno.
Journal of Environmental Health JEVHAH, Vol. 48, No. 3, p 116-121, November/December 1985. 1 fig, 1 tab, 27 ref.

Descriptors: *Groundwater pollution, *Organic compounds, *Groundwater management, *Public health, *Water pollution sources, Water pollution prevention, Water quality control, Water quality management, Drinking water, Landfills, Leachates, Organic solvents, Legislation.

Groundwater contamination by synthetic organic chemicals (SOCs) is a significant environmental health problem that has only recently gained national recognition. Lack of adequate testing requirements for organic contaminants in drinking water, the unique hydrogeological characteristics of groundwater, the quantity and variety of waste disposal and non-waste disposal sources of contamination, and the practical absence of drinking water standards for toxic organic compounds have contributed to the complexity of the problem. A recent EPA survey found that 80% of the nationwide cases of groundwater contamination by SOCs involved trichlorethylene. Sources for contamination were linked to leaking underground storage tanks, improper waste disposal methods for solvents, the use of septic tank cleaning solutions containing organic compounds, and leachates from landfills, surface impoundments, and dumps. Increasingly sensitive analytical and risk assessment capabilities have continued to link lower levels of organic compounds to chronic health conditions. Solutions to the problem of groundwater pollution have been hampered by lack of comprehensive and relevant legislation and coordinated efforts at the federal, state, and local levels. State and local agencies can respond to the problem by prompt

investigation of identified problems, developing adequate facilities for the screening of SOCs and other non-traditional pollutants in groundwater, regularly collecting groundwater quality data, increasing public education, and adopting better land use planning methods. (Geiger-PTT)
W86-04609

SUMMARY OF WATERBORNE ILLNESS TRANSMITTED THROUGH CONTAMINATED GROUNDWATER,
Environmental Protection Agency, Cincinnati, OH.
For primary bibliographic entry see Field 5C.
W86-04610

ORGANIC CONTAMINANTS IN GROUNDWATER,
Environmental Protection Agency, Dallas, TX. Region VI.
For primary bibliographic entry see Field 5G.
W86-04617

RELATIONSHIP BETWEEN ACID PRECIPITATION AND THREE-DIMENSIONAL TRANSPORT ASSOCIATED WITH SYNOPTIC-SCALE CYCLONES,
National Center for Atmospheric Research, Boulder, CO.
P. L. Haagenson, A. L. Lazrus, Y. H. Kuo, and G. A. Caldwell.
Journal of Climate and Applied Meteorology JCAMEJ, Vol. 24, No. 9, p 967-976, September 1985. 17 fig, 1 tab, 19 ref. EPA Grant EPA-AD-49F-0-028-0.

Descriptors: *Acid rain, *Model studies, *Hydrologic models, *Cyclones, *Sulfur compounds, *Synoptic-Scale cyclones, Precipitation, Acidity, Hydrogen ion concentrations, Storms, Air pollution, Path of pollutants, Fate of pollutants, Acidic water.

Field data collected during the Acid Precipitation Experiment (APEX) were used in conjunction with an isentropic trajectory model to analyze the relationship between acid precipitation and three-dimensional transport associated with cyclonic storms. Results indicate that high acidity in precipitation is often associated with slow transport speed and elevated SO2 concentrations in the dry air feeding into the precipitating regions. Conversely, low acidity is usually related to rapid transit, descending motion, and transport above the atmospheric boundary layer. Also, precipitation in the cold sector of a cyclone (in advance of the surface warm front) is often more acidic than that in other sectors of the storm. Four case studies demonstrate some of these meteorological effects. Cases studied were warm-sector samples obtained in the boundary layer, cold sector samples in cold air following the cold front, warm-sector sector samples obtained above the boundary layer, and cold sector samples in the cold sector in advance of the surface warm front. (Geiger-PTT)
W86-04629

MODEL FOR SEDIMENT OXYGEN DEMAND IN LAKES,
Beak Consultants Ltd., Mississauga (Ontario).
R. R. Walker, and W. J. Snodgrass.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 25-43, February 1986. 5 fig, 2 tab, 42 ref, 1 append.

Descriptors: *Lake sediments, *Sediment oxygen demand, *Models, *Biological oxygen demand, *Chemical oxygen demand, Mathematical models, Kinetics, Biodegradation, Oxygen transfer, Wastewater pollution, Eutrophication.

A model for sediment oxygen demand (SOD) in lakes was developed for aerobic (BSOD) and chemical (CSOD) components. The CSOD uses first order kinetics while BSOD uses Monod kinetics with respect to oxygen concentration. The model is calibrated using laboratory data for sediments from four lakes - one heavily impacted by eutrophication and wastewater discharges, while the other three lay on the forested Precambrian shield. Model values showed excellent agreement with laboratory data for all water bodies for temperatures between 4 and 22 degrees. The model implies that CSOD is diffusion controlled at one temperature, but strongly dependent on anaerobic biological processes over a range of temperatures. To complete model development, future research should aim to incorporate overlying water velocity and sediment biodecomposability into kinetic expressions. (Geiger-PTT)
W86-04639

ASSESSING PHOSPHORUS CONTROL IN THE JAMES RIVER BASIN,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04640

EFFECT OF THREE DRILLING FLUIDS ON GROUND WATER SAMPLE CHEMISTRY,
Geological Survey, San Antonio, TX. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-04655

INTERPRETATION OF VLF RESISTIVITY DATA FOR GROUND WATER CONTAMINATION SURVEYS,
University of South Florida, Tampa. Dept. of Geology.
M. Stewart, and R. Bretnall.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 71-75, Winter 1986. 8 fig, 7 ref.

Descriptors: *Groundwater pollution, *Geophysical surveys, *Radio waves, *Very low frequency communications, *Resistivity, Geophysics, Magnetic studies, Vertical flow, Groundwater movement.

Shallow geophysical surveys to locate groundwater contamination and vertical geologic contacts, can be facilitated with the use of very low frequency (VLF) military communications systems. Useful properties that can be easily obtained from the interaction of the earth and the primary field are the magnitude of the vertical secondary magnetic field, the surface impedence, and the phase angle between the electrical and magnetic horizontal components. The variations in the secondary magnetic field can be related to vertical geologic contacts, such as the edges of landfill trenches. The surface impedence yields an apparent terrain conductivity, which can be used to locate low-resistivity anomalies often associated with contaminated groundwater. The phase angle gives information on vertical variations in resistivity, phase angles less than 45 degrees, indicating increasing resistivity with depth. The depth of penetration of the VLF field is about one skin depth. For a frequency of 20 kHz, with skin depth in meters is approximately equal to 3.6 x square root of p, where p is terrain resistivity in ohmmeters. (Lantz-PTT)
W86-04656

COMPUTER DATA BASE FOR OVERVIEW OF GROUND WATER POLLUTION INVESTIGATIONS,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
For primary bibliographic entry see Field 7C.
W86-04657

METHOD FOR SIMULTANEOUS IN SITU MEASUREMENT IN THE VADOSE ZONE OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY AND THE CONDUCTIVITY-PRESSURE HEAD RELATIONSHIP,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
W. D. Reynolds, and D. E. Elrick.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 84-95, Winter 1986. 4 fig, 3 tab, 31 ref.

Descriptors: *Vadose water, *In situ tests, *Geulph permeameter, *Hydraulic conductivity, *Hydraulic sorptivity, Pressure head, Steady flow, Experimental design.

The Guelph Permeameter (GP) method for simultaneous, in situ measurement in the vadose zone of field-saturated hydraulic conductivity (K sub fs), sorptivity (S) and the conductivity-pressure head relationship (K(theta)) is described and discussed. The method involves measuring the steady-state liquid recharge, Q, necessary to maintain a constant depth of water, H, in an uncased, cylindrical well of radius, a, finished above the water table. An 'in-hole' Mariotte bottle device is used to maintain H and to measure Q. Step-by-step procedures with example calculations are given for obtaining K sub fs, S and K(theta). Techniques for assessing the results are also given. The GP method will (theoretically) yield simultaneous, in situ measurements of K sub fs and K(theta) for infiltration of any wet liquid, and yields a 'point' measurement requiring replication. The GP apparatus is inexpensive, simple and easily operated by one person. The method can be used to obtain vertical profiles of K sub fs, S and alpha, requiring less time per measurement than most other methods. (Lantz-PTT)
W86-04659

GAS METABOLISM EVIDENCE IN SUPPORT OF THE JUXTAPOSITION OF HYDROGEN-PRODUCING AND METHANOGENIC BACTERIA IN SEWAGE SLUDGE AND LAKE SEDIMENTS,
Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
For primary bibliographic entry see Field 5C.
W86-04665

MODELING THE RESPONSE OF GREENHOUSE-GROWN RADISH PLANTS TO ACIDIC RAIN,
Argonne National Lab., IL. Environmental Research Div.
For primary bibliographic entry see Field 5C.
W86-04668

RESPONSES OF THREE WHEAT CULTIVARS TO SIMULATED ACID RAIN,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5C.
W86-04669

ENTEROVIRUSES IN SLUDGE: MULTIYEAR EXPERIENCE WITH FOUR WASTEWATER TREATMENT PLANTS,
Ohio State Univ., Columbus. Dept. of Medical Microbiology.
For primary bibliographic entry see Field 5D.
W86-04671

INCIDENCE OF VIBRIO CHOLERAE AND RELATED VIBRIOS IN A COASTAL LAGOON AND SEAWATER INFLUENCED BY LAKE DISCHARGES ALONG AN ANNUAL CYCLE,
Valencia Univ. (Spain). Dept. of Microbiology.
For primary bibliographic entry see Field 5C.
W86-04674

SURVIVAL AND ENUMERATION OF THE FECAL INDICATORS BIFIDOBACTERIUM ADOLESCENTIS AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
M. Carrillo, E. Estrada, and T. C. Hazen.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 468-476, August 1985. 4 fig, 3 tab, 34 ref. PHS Grant 8102, Sea Grant UPR SG 04F15844030, Project EN/P-45.

Descriptors: *Forest watersheds, *Biological indicators, *Tropical regions, Bifidobacterium adolescentis, Escherichia coli, Coliforms, Survival, Bacteria, Ecological effects, Puerto Rico, Bacterial analysis.

The density of Bifidobacterium spp., fecal coliforms, Escherichia coli, and total anaerobic bacteria, acridine orange direct counts, percentages of total bacterial community activity and respiration, and 12 physical and chemical parameters were measured simultaneously at six sites for 12 months in the Mameyes River rain forest watershed, Puerto Rico. The densities of all bacteria were higher than those reported for uncontaminated temperate rivers, even though other water quality parameters would indicate that all uncontaminated sites were oligotrophic. The highest elevation site in the watershed had the highest densities. Correlations between bacterial densities, nitrates, temperature, phosphates, and total phosphorus indicated that all viable counts were related to nutrient levels, regardless of the site sampled. In situ diffusion chamber studies at two different sites indicated that E. coli could survive, remain physiologically active, and regrow at rates that were dependent on nutrient levels of the ambient waters. Bifidobacterium adolescentis did not survive at either site but did show different rates of decline and physiological activity at two sites. Bifidobacteria show promise as a better indicator of recent fecal contamination in tropical freshwaters than E. coli or fecal coliforms; however, the YN-6 medium did not prove to be effective for enumeration of bifidobacteria. The coliform maximum contaminant levels for assessing water usability for drinking and recreation appear to be unworkable in tropical freshwaters. (Author's abstract)
W86-04675

SULFATE-REDUCING BACTERIA: PRINCIPAL METHYLATORS OF MERCURY IN ANOXIC ESTUARINE SEDIMENT,
Rutgers - The State Univ., New Brunswick, NJ. Dept. of Biochemistry and Microbiology.
G. C. Compeau, and R. Bartha.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 498-502, August 1985. 3 fig, 2 tab, 21 ref.

Descriptors: *Sulfur bacteria, *Methylation, *Mercury, *Estuarine sediments, Salt marshes, Desulfovibrio desulfuricans, Cultures, Pollutant identification, Bioindicators, Anoxic water.

Substrate-electron acceptor combinations and specific metabolic inhibitors were applied to anoxic saltmarsh sediment spiked with mercuric ions ($Hg(2+)$) in an effort to identify, by a direct approach, the microorganisms responsible for the synthesis of hazardous monomethylmercury. 2-Bromoethane sulfonate (30 mM), a specific inhibitor of methanogens, increased monomethylmercury synthesis, whereas sodium molybdate (20mM), a specific inhibitor of sulfate reducers, decreased $Hg(2+)$ methylation by more than 95%. Anaerobic enrichment and isolation procedures yielded a Desulfovibrio desulfuricans culture that vigorously methylated $Hg(2+)$ in culture solution and also in samples of presterilized sediment. The $Hg(2+)$ methylation activity of sulfate reducers is fully expressed only when sulfate is limiting and fermentable organic substrates are available. To date, sulfate reducers have not been suspected to $Hg(2+)$ methylation. Identification of these bacteria as the principal methylators of $Hg(2+)$ in anoxic sediments raises questions about the environmental relevance of previous pure culture-based methylation work. (Author's abstract)
W86-04676

5C. Effects Of Pollution

PREY SELECTION AND FEEDING PATTERNS OF FISH IN A SOUTHERN UNITED STATES HYDROPOWER TAILWATER,
Fish and Wildlife Service, Fayetteville, AR. National Reservoir Research Program.
D. H. Barwick, P. L. Hudson, and J. M. Nestler.
Miscellaneous Paper E-85-1, October 1985. Final Report. 21 p, 4 tab, 22 ref.

Descriptors: *Power plants, *Hydroelectric plants, *Fish, *Fish food, Aquatic life, Water quality, Tailwater, Reservoirs, Moxostoma anisurum, Lepomis auritus, Lepomis cyaellus, Lepomis machrochirus.

The downstream effects of peaking hydropower generation at Lake Hartwell Georgia-South Carolina, on the diel prey selection and feeding of four species of fish -- silver redhorse (Moxostoma anisurum), redbreast sunfish (Lepomis auritus), green sunfish (L. cyanellus), and bluegill (L. machrochirus) -- were determined. Aquatic insects (primarily dipterans, ephemeropterans, and trichopterans), crayfish, and terrestrial organisms (primarily insects) composed most of the food eaten. These fish fed primarily during daylight, before daily hydropower generation began, and little or no feeding occurred during generation. Consequently, few organisms entrained from the reservoir or displaced from the tailwater during hydropower generation were eaten by these fish. (Author's abstract)
W86-03902

DISPERSION AND SELF-PURIFICATION OF POLLUTANTS IN SURFACE WATER SYSTEMS,
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
For primary bibliographic entry see Field 5B.
W86-03906

ACID DEPOSITION: EFFECTS ON TERRESTRIAL ECOSYSTEMS,
Oak Ridge National Lab., TN. Environmental Sciences Div.
For primary bibliographic entry see Field 5B.
W86-03908

RESULTS OF 4-M3 LNG SPILLS ONTO WATER,
Lawrence Livermore National Lab., CA.
For primary bibliographic entry see Field 5B.
W86-03909

EFFECTIVENESS, BEHAVIOR, AND TOXICITY OF DISPERSANTS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
D. Mackay, and P. G. Wells.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p. 65-71, 3 fig, 2 tab, 11 ref.

Descriptors: *Dispersants, *Toxicity, *Environmental effects, *Oil slicks, *Diffusion, *Effectiveness, *Benthos, Surfactants, Oil, Bottom sediments, Suspended sediments, Water column, Mackay-Nadeau-Steelman System.

Three key issues must be addressed when deciding on the desirability of using chemical dispersants for mitigating the adverse effects of oil spills: (1) how effective a given dosage of dispersant will be on a given oil slick; (2) how the dispersed oil and dispersant diffuse into the water column, dissolve, volatilize, degrade, and interact with suspended and bottom sediments; and (3) what effects the dissolved and particulate oil and dispersant will have on water column and benthic biota. It is essential that the first two areas (physical and chemical studies) relate closely to the third (biological aspects) in order that bioassay exposure (in terms of concentration of dispersant, classes of and individual hydrocarbons, and duration) addressing the toxicity issue be realistic. Here, we review the current status of a research program which addresses these issues. Under the program, attempts are being made to quantify dispersant effectiveness (including consideration of effectiveness testing using the Mackay-Nadeau-Steelman system for oils which have evaporated and/or formed water-in-oil emulsions to various extents), water column diffusion, and partitioning of specific hydrocarbons among water, oil, and suspended sediment as well as into the atmosphere. A procedure is described which has been used to quantify the acute toxicity of dispersants to copepods and which is being extended to apply also to the toxic contributions of dissolved and particulate oil. Hopefully, by assembling quantitative expressions for effectiveness, behavior, and toxicity, those situations in which dispersion is desirable can be better identified. (Author's abstract)
W86-04010

ECOLOGICAL MAPPING AND CLEANUP OF OIL SPILLS ONSHORE,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W86-04018

OIL SPILL ON NORTHERN SHORELINES: AN EVALUATION OF SOME OPTIONS DEALING WITH THIS PROBLEM,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5G.
W86-04022

OIL DEGRADATION AND ENVIRONMENTAL IMPACT OF VARIOUS CO-DISPOSAL METHODS,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5E.
W86-04024

TESTING OF CRUDE OILS AND PETROLEUM PRODUCTS FOR ENVIRONMENTAL PURPOSES,
Toronto Univ. (Ontario). Dept. of Chemical Engineering and Applied Chemistry.
D. Mackay, W. Stiver, and P. A. Tebeau.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 331-337, 4 fig, 1 tab, 27 ref.

Descriptors: *Oil, *Environmental effects, *Ecological effects, *Petroleum products, Chemical analysis, Chemical properties, Oil pollution.

When crude oil or a petroleum product is to be produced or transported in the marine environment, there is always a risk of spills. To assess the nature of the risk and the likely behavior of the spilled oil, it is desirable to test the oil for those properties which will determine its environmental behavior and effects. Further, the properties should be expressed in the form of parameters in equations which are suitable for direct incorporation into oil spill models. Suitable tests for properties such as chemical composition, density, viscosity or rheology, volatility, aqueous solubility, and interfacial properties are suggested and equations suggested for these properties as a function of temperature and extent of weathering. Tests which can be used to predict the rates of environmental processes such as evaporation, water-in-oil emulsion formation, natural and chemically induced dispersion and spreading are also reviewed and test inadequacies identified. A reasonably complete test protocol can be established now but some problems remain, especially with regard to characterization of an oil's natural dispersability. (Author's abstract)
W86-04027

FATE OF TWO LARGE OIL SPILLS IN THE ARABIAN GULF,
University of Petroleum and Minerals, Dhahran (Saudi Arabia). Research Inst.
For primary bibliographic entry see Field 5B.
W86-04030

HASBAH 6 (SAUDI ARABIA) BLOWOUT: THE EFFECTS OF AN INTERNATIONAL OIL SPILL AS EXPERIENCED IN QATAR,
Shell International Petroleum Mij., The Hague (Netherlands).
J. A. Van Oudenhoven.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3,

1983, San Antonio, Texas. p 381-388, 5 fig, 2 tab, 3 ref.

Descriptors: *Oil spills, *Environmental effects, *Path of pollutants, *Distribution patterns, Environmental effects, Planning, Oil, Hasbah 6, Saudi Arabia, Care studies.

An oil well blowout in the Arabian Gulf lasted only eight days; however, the resultant oil spill threatened neighboring coasts for as long as two months. On windy days, nearly neutrally buoyant oil slicks approaching the Qatar coasts seemed to disappear, but they soon surfaced again whenever the weather improved. Qatar, suddenly faced with a very unusual spill, did not have an oil spill response plan. Throughout the emergency, therefore, valuable time was lost discussing the appropriate measures and setting protection priorities. Often, any understanding of the nature of the problems involved was lacking. Although most beaches became covered with the tar-like substance, a small task force from the state oil company, supported by a few foreign advisers, was able to protect all the important water intakes. Examples are given of how general principles were adapted to the specific local circumstances; for instance, lagoons were used to trap and handle the oil, and discarded SBM hoses served as breakwaters. To ensure an environmentally responsible cleaning operation, the few personnel available were provided with lists of do's and don'ts.The effectiveness of various approaches to dispose of collected oil is discussed. A framework for an oil spill contingency plan for Qatar has been developed and a government environmental committee set up. The oil companies' mutual aid organization, put to the test, revealed weak areas, such as transboundary and communication problems, forcing the partners to review the organization. To enhance in-house response, the state oil company purchased spill-response equipment and is considering hands-on training of emergency crews. The valuable experience gained during this emergency should be used to improve future spill preparedness. (Author's abstract)
W86-04031

BIOLOGICAL MONITORING OF THE FORTIES OILFIELD (NORTH SEA),
Field Studies Council, Pembroke (Wales). Oil Pollution Research Unit.
For primary bibliographic entry see Field 5A.
W86-04033

BIOS PROJECT: AN UPDATE,
Environmental Protection Service, Edmonton (Alberta).
For primary bibliographic entry see Field 5B.
W86-04035

EFFECT OF SPILLS OF DISPERSED AND NON-DISPERSED OIL ON INTERTIDAL INFAUNAL COMMUNITY STRUCTURE,
Bowdoin Coll., Brunswick, ME.
E. S. Gilfillan, S. A. Hanson, D. Vallas, R. Gerber, and D. S. Page.
In: Proceedings of the 1983 Oil Spill conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 457-463, 6 fig, 4 tab, 18 ref.

Descriptors: *Oil spills, *Intertidal areas, *Dispersion, Infaunal communities, Environmental effects, Oil pollution, Oil, Sensitivity analysis.

The effect of two nearshore discharges of Murban crude oil on community structure in intertidal benthic communities was studied. One discharge consisted of 250 gallons of Murban crude only. Following the discharge, no measurable amount of Murban crude could be found in sediments exposed to the cloud of dispersed oil. Significant amounts were found in the test plot exposed to untreated oil. In the area exposed to untreated oil, more oil was found in the upper intertidal zone than lower down. Effects on infaunal communities mirrored the analytical results. There was no evidence of adverse effects on infaunal community structure from exposure to dispersed oil. There is clear evidence that exposure to untreated oil did adversely affect community structure. Some indigenous species were reduced in number or eliminated; there were blooms of opportunistic polychaetes. The changes in community structure brought about by the untreated oil are consistent with results observed at real-world oil spill sites. (Author's abstract)
W86-04036

LONG-TERM FATE OF DISPERSED AND UNDISPERSED CRUDE OIL IN TWO NEARSHORE TEST SPILLS,
Bowdoin Coll., Brunswick, ME.
D. S. Page, J. C. Foster, J. R. Hotham, E. Pendergast, and S. Hebert.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 465-471, 11 fig, 3 tab, 13 ref.

Descriptors: *Oil spills, *Water pollution effects, *Cleanup operations, *Dispersants, *Fate of pollutants, Testing procedures, Environmental effects, Distribution patterns, Oil, Oil pollution.

The fate and effects of two nearshore discharges of Murban crude oil at Long Cove, Searsport, Maine in August 1981 were studied following a one-year, pre-spill baseline study of the test areas. an upper and a lower intertidal sampling area within a 60 x 100 meter test plot were exposed to dispersed oil in water resulting from the discharge of 250 gallons of oil pre-mixed with 25 gallons of Corexit 9527 dispersant. Release of treated oil was around high-water slack tide on the surface of the water, with added mixing energy provided by mixing gates deployed by small boats. The maximum water depth over the test areas was 3.5 meters. Untreated crude oil (250 gallons) was released on an ebbing tide within a separate, boomed-off 60 x 100 meter test plot. A third test plot served as an oil-free reference plot. Water samples taken near the bottom during and after discharge showed that chemically dispersed oil loses lower boiling hydrocarbons in both the aliphatic and aromatic fractions below n-C17 as the droplets diffuse downward. Data are given for sediment samples taken from the test plots 11 months pre-spill and 10 months post-spill. Hydrocarbon analyses of the sediment samples show little incorporation of dispersed oil into the sediments of the treated oil plot relative to the sediments exposed to undispersed oil. (Author's abstract)
W86-04037

POTENTIAL DAMAGE OF OIL WASTES IN COASTAL ESTUARY SEDIMENTS,
J. S. Lytle, and T. F. Lytle.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 491-500, 6 figs, 3 tabs, 33 ref.

Descriptors: *Sediments, *Estuaries, *Water pollution effects, *Ecological effects, *Oil wastes, Oil pollution, Chemical analysis, Minnows, Shrimp, Amphipods, Oil.

Bayou Casotte, Mississippi, an estuarine waterway near the eastern end of Mississippi Sound, has been altered to accommodate an extensive industrial complex including a large oil refinery. Several small oil spill accidents recently occurred in the bayou; the most serious, on June 13, 1981, involved 600 barrels of asphaltic crude. the ecological effects of continued exposure to low level oily wastes were estimated by examining pollution levels in sediments both in 10-foot cores and surface samples. Petroleum hydrocarbons (PHC) and other hydrocarbons occur at levels as high as 12,300 micrograms per gram (mu g/g or ppm to total hydrocarbons, dry weight) in surficial sediments and 1,000 mu g/g at 120 centimeter sediment depths. Dredging operations have removed most polluted sediments very near the refinery site in the bayou, but dispersal of petroleum wastes has caused PHCs to be dominant pollutants in other regions where no dredging has occurred and where care is required if any dredging is permitted. Toxicological examination of sheepshead minnows, mysid shrimp and amphipods reveals significant mortalities to mysids from bioassay exposures to surficial sediments. Settling rate determinations, leachability, community structure vulnerability, and sediment disturbance probability are factors assimilated into an 'environmental stress index' that indicates this to be a potentially harmful site to bottom feeders and, if sediments are disturbed, to free swimming organisms in sensitive life stages. (Author's abstract)
W86-04038

GEOMORPHOLOGICAL IMPACT OF CLEAN-UP OF AN OILED SALT MARSH (ILE GRANDE, FRANCE),
Institut National de la Recherche Scientifique, Rimouski (Quebec).
B. F. Long, and J. H. Vandermeuler.
In: Proceedings of the 1983 Oil Spill conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 501-505, 12 fig, 3 ref.

Descriptors: *Geomorphology, *Water pollution effects, *Salt marshes, *Oil pollution, *Drainage systems, Channel morphology, Artificial water courses, Sediment erosion, Erosion, Ile Grande, France.

As a result of removal of surface sediment following heavy oiling from the Amoco Cadiz spill (March 1978), the Ile Grande marsh has undergone rapid erosion, instead of continuing in the normal depositional phase of formation. This resulted directly from the sediment removal, which led to increased water flow velocities through the marsh. Four years after the cleanup, the old marsh drainage system, based on the equilibrium between channel cross section, channel slope, tidal current velocity and marsh sediments (grain size, stabilization through vegetation), has been replaced by a new artificial drainage system. The principal factor in the new system is the formation of a new meander channel system with increased cross sections of primary and secondary draining channels (tidal prism), slumping of channel banks and widening of the meanders. Primary and secondary channels, in both the mudflat and the upper vegetative zones, now exhibit meander channel valleys of 5.4 to 15 meters wide, and 1 m deep (the original width was 0.5 to 1 m). The beds of some of these channels, formerly of silt, now are the sites of sandbar formation. Thus the marsh is a continuing erosional phase. The process is accelerated by the erosion of the interior vegetative zone through the washout and enlargement of the marsh pools on the upper part of the marsh. Normally not part of the marsh drainage system, these were connected to the marsh channels by hand-dug ditches at the time of cleanup, thereby allowing tidal flow into the upper, low-energy marsh. (Author's abstract)
W86-04039

NATURAL RESOURCES DAMAGE ASSESSMENT STUDY: THE IXTOC I BLOWOUT,
Energy Resources Co., Inc., Cambridge, MA.
P. D. Boehm, D. L. Fiest, I. Kaplan, and P. Mankiewicz.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 507-515, 9 fig, 16 ref.

Descriptors: *Oil spills, *Natural resources, *Water pollution effects, *Resources assessment, *Benthic environment, Damage, Environmental effects, Ecological effects, Chemical analysis, Oil.

Following the Ixtoc I blowout and Burmah Agate spill in 1979, a program was initiated to investigate the extent of damage to the offshore benthic environment. A program of chemical and biological measurements was conducted based on samples taken during and after the spills and compared with results obtained in a baseline program conducted before the spills. A new chemical method combining molecular (gas chromatography/mass

spectrometry) and atomic (stable isotope) measurements was used to identify the source of weathered oil residues. The program concluded that the important biological changes observed cannot be attributed to a chemical impact from either spill and hence must be attributed to other causes. (Author's abstract)
W86-04040

SPILL OF LIGHT FUEL OIL IN THE BALTIC SEA,
Swedish Environmental Research Inst., Karlskrona.
O. Linden, J. Mattson, and M. Notini.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 517-520, 2 fig, 4 tab, 16 ref.

Descriptors: *Oil spills, *Ecological effects, *Water pollution effects, *Biochemical analysis, *Littoral environment, Dispersion, Dispersants, Fauna, Biomass, Oil pollution, Oil, Baltic Sea.

The impact of a spill of about 375 tons of light fuel oil in the southern Baltic Sea has been studied for one year. The spill originated from the tanker Sefir which sank to a 50 meter depth about six nautical miles east of the island of Oland. The study showed that the oil formed droplets which were taken up by zooplankton. Up to 50 percent of the zooplankton died during the acute phase of the spill. The oil droplets were well dispersed and sedimented over large areas. In six weeks during the acute phase of the spill, about 20,500 kilograms of oil corresponds to about 5.5 percent of the total amount of lost oil. Bivalves showed some uptake of oil. The littoral fauna was reduced drastically over a 10 km stretch of the coast. Only 2 percent of the fauna survived. The biomass and number of species also dropped considerably. One year after the spill, a slight recovery could be observed. The severe impact in the littoral zone was caused by a combination of the high toxicity of the oil and the low water exchange in the shallow water. In addition, the low water temperature preserved the toxic properties of the oil. (Author's abstract)
W86-04041

COMBINED USE OF GENOTOXICITY AND WHOLE EMBRYO TERATOGENICITY SCREENING ASSAYS IN PREDICTING TERATOGENIC RISKS,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
J. A. Bantle, and C. L. Courchesne.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 175-176, 4 fig, 7 ref. Contract No. 15-30.

Descriptors: *Amphibians, *Toxicity, *Water pollution effects, *Bioindicators, *Bioassay, Teratogenicity, Genotoxicity, Embryos, Xenopus laevis, Biosynthesis, Ribonucleic acid, Deoxyribonucleic acid, RNA, DNA.

Whole amphibian embryo teratogenicity assays are useful for predicting risk to aquatic species. However, extrapolation of data to other systems is difficult because of differing metabolisms and other factors. One way to make whole embryo teratogenicity assays more predictive is to understand which molecular mechanisms are inhibited. If such mechanisms are common to many species, then results of both assays complement one another. Whole embryo teratogenicity assays use embryos of the frog Xenopus laevis. Endpoints measured were 96 h lethality, malformation, growth, and the teratogenicity index (LC50/ EC50 malformation). Our genotoxicity bioassay measures the ability of a substance to alter RNA of protein biosynthesis. This assay involves treatment of the plasmid pHSV-106 containing the herpes thymidine kinase (TK) gene with the test substance. The plasmid is then microinjected into Xenopus oocytes and the amount of TK made is assayed. The second genotoxicity assay involves injecting TK gene, exposing the oocyte, and then measuring TK production. This assay measures the agent's ability to interfere with the metabolic machinery that makes protein. We have validated both assays using known inhibitors of DNA, RNA and protein synthesis. (Author's abstract)
W86-04088

USE OF THE ELECTRICAL POTENTIAL OF CELL MEMBRANES TO RAPIDLY ASSESS POTENTIAL TOXICANTS,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
For primary bibliographic entry see Field 5A.
W86-04091

INDICES IDENTIFYING SUBSURFACE MICROBIAL COMMUNITIES THAT ARE ADAPTED TO ORGANIC POLLUTION,
Florida State Univ., Tallahassee. Center for Biomedical and Toxicological Research.
For primary bibliographic entry see Field 5B.
W86-04099

EFFECT OF NAPHTHALENE ON SOIL AND FRESH-WATER ALGAE,
Oklahoma State Univ., Stillwater. Dept. of Zoology.
V. G. Struble, and H. J. Harmon.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 214-216, 4 tab, 14 refs.

Descriptors: *Groundwater, *Soils, *Algae, *Surface water, *Naphthalene, Microenvironment, Aromatic hydrocarbons, Organic compounds, Chlamydomonas moewusii, Chlorella pyrenoidosa, Photosynthesis, Respiration.

Organisms present in microcommunities may alter the presence or nature of contaminants in soils, ground water, and surface waters. The survival and viability of these microorganisms after exposure to contaminants either from surface spills or seepage can be important in the fate and transport of the contaminants. Representative organisms from the microcommunities may be used to predict or indicate the responses of other organisms of the microcommunity. In this study, the effects of the ubiquitous pollutant naphthalene, a polycyclic aromatic hydrocarbon, on respiration and photosynthetic oxygen evolution of two algae species was determined polarographically. Chlamydomonas moewusii is a representative eucaryotic soil alga. Exposure of the log phase organism to 15 to 30 ppm naphthalene inhibited both oxygen consumption and evolution. A two hour exposure resulted in an increase in inhibition of both rates. Chlorella pyrenoidosa is a representative eucaryotic fresh water alga. Oxygen evolution rates were affected by naphthalene in a similar manner as with Chlamydomonas. However, with stationary phase cells, exposure to all concentrations inhibited respiration by at least 30%, with rates approaching those of controls for all but cultures exposed to 30 ppm after 2 hours. Respiration by log phase cells was stimulated by exposure to 30 ppm while lower concentrations were inhibitory; rates approached those of controls after 2 hours. Exposure to the higher concentrations of naphthalene induced morphological variations in both types of algae after 24 and 48 hours. (Author's abstract)
W86-04100

ABUNDANCE, HETEROTROPHIC ACTIVITY AND TAXONOMY OF BACTERIA IN A STREAM SUBJECT TO POLLUTION BY CHLOROPHENOLS, NITROPHENOLS AND PHENOXYALKANOIC ACIDS,
Hull Univ. (England). Dept. of Plant Biology.
C. R. Milner, and R. Goulder.
Water Research WATRAG, Vol. 20, No. 1, p 85-90, January 1986. 6 tab, 43 ref.

Descriptors: *Heterotrophic bacteria, *Taxonomy, *Streams, *Chlorophenols, *Nitrophenols, *Phenoxyalkanoic acids, Water pollution, High performance liquid chromatography, Yorkshire, England, Pseudomonas, Statistical analysis.

Analysis by HPLC identified 14 individual chlorophenols, nitrophenols and phenoxyalkanoic acids in a small stream in West Yorkshire; concentrations fluctuated markedly over 12 months. Abundance of bacteria (as direct counts and colony-forming units) and heterotrophic activity (as fraction of glucose substrate mineralized) were measured in water and artificial gravel substratum at two sites in this stream. Mean bacterial abundance, and at one site activity, were at least similar to those found in an adjacent unpolluted stream. Sometimes, however, colony-forming units and activity were depressed. Multiple-regression analysis demonstrated relationships between bacteria and pollution-related variables; low pH and nitrophenols (particularly picric acid), were identified as possible causes of bacterial inhibition. Taxonomic investigation of isolates from sediment demonstrated that bacteria in the polluted stream were dominated by Pseudomonas, whereas a wide range of mainly Gram-negative bacteria was present in the unpolluted stream. (Author's abstract)
W86-04113

COMPARISON OF ALGAL ASSAY SYSTEMS FOR DETECTING WATERBORNE HERBICIDES AND METALS,
Montana State Univ., Bozeman. Dept. of Microbiology.
For primary bibliographic entry see Field 5A.
W86-04114

STATIC SHAKE-FLASK BIOTRANSFORMATION OF ENDOTHALL,
North Texas State Univ., Denton. Dept. of Biological Sciences.
K. H. Reinert, J. H. Rodgers, T. J. Leslie, and M. L. Hinman.
Water Research WATRAG, Vol. 20, No. 2, p 255-258, February 1986. 2 fig, 4 tab, 21 ref.

Descriptors: *Aquatic herbicides, *In vitro tests, *Aquatic plants, *Biotransformation, Kinetics, Reservoirs, Biodegradation, Herbicides, Endothall.

Laboratory biotransformation and biodegradation rate coefficient were determined for the aquatic herbicide, endothall. Concentrations of 0.5, 2.0 and 4.0 mg/l endothall were employed in a static shake-flask test containing reservoir water. A pseudo-first-order biotransformation rate coefficient of 0.083/day and an aqueous half-life of 8.45 days were calculated for endothall from this study. Test results support endothall as an environmentally labile aquatic herbicide with respect to biotransformation, which suggests that an adequate margin of safety exists for endothall application in aquatic environments. (Lantz-PTT))
W86-04132

SEASONAL VARIATION IN WEATHERING AND TOXICITY OF CRUDE OIL ON SEA-WATER UNDER ARCTIC CONDITIONS,
Tromsoe Univ. (Norway). Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04134

BIOCONCENTRATION FACTORS OF SOME HALOGENATED ORGANICS FOR RAINBOW TROUT: LIMITATIONS IN THEIR USE FOR PREDICTION OF ENVIRONMENTAL RESIDUES,
National Water Research Inst., Burlington (Ontario). Environmental Contaminants Div.
B. G. Oliver, and A. J. Niimi.
Environmental Science and Technology ESTHAG, Vol. 19, No. 9, p 842-849, September 1985. 1 fig, 7 tab, 49 ref.

Descriptors: *Biological concentration, *Organic compounds, *Trout, *Bioaccumulation, *Halogenated pesticides, Fish, Pesticides, Pesticide residues, Pesticide kinetics, Water pollution effects, Pollutant identification, Water analysis, Hydrocarbons, Absorption, Chlorine, Bromine, Lake Ontario.

The bioconcentration factors, BCF's for 34 chlorinated and brominated chemicals in rainbow trout have been determined by the steady-state approach by using chemical water concentrations in the nanogram per liter range. In addition, for 13 chemicals with a known half-life in trout, BCF's were also estimated by using the kinetic approach. The two methods gave comparable results for compounds with short half-lives in the fish but significantly different results for longer half-life chemicals. The BCF's have been shown to correlate well with octanol/water partition coefficients for many of the study compounds. But the BCF's of high molecular weight compounds and compounds metabolized by the fish did not correlate with octanol/water partition coefficients. The laboratory-derived BCF's were compared to field-derived BCF's for Lake Ontario rainbow trout. This comparison showed that predictions based on laboratory BCF's were useful for chemicals with short half-lives in fish but were much too low for long half-life chemicals, where contaminated food is the major chemical source. (Author's abstract)
W86-04142

BIOAVAILABILITY AND BIOTRANSFORMATION OF AROMATIC HYDROCARBONS IN BENTHIC ORGANISMS EXPOSED TO SEDIMENT FROM AN URBAN ESTUARY,
National Marine Fisheries Service, Seattle, WA. Northwest and Alaska Fisheries Center.
U. Varanasi, W. L. Reichert, J. E. Stein, D. W. Brown, and H. R. Sanborn.
Environmental Science and Technology ESTHAG, Vol. 19, No. 9, p 836-841, September 1985. 2 fig, 4 tab, 24 ref.

Descriptors: *Aromatic compounds, *Hydrocarbons, *Marine sediments, *Bioaccumulation, *Marine animals, *Biotransformation, *Estuaries, Water pollution effects, Shrimp, Benthos, Clams, Mollusks, Fish, Metabolism, Amphipoda, Gas chomatography, Mass spectrometry, High pressure liquid chromatography, Fluorescence spectrometry.

Phylogenetically diverse benthic organisms (amphipods - Rhepoxynius abronius and Eohaustorius washingtonianus; clams - Macoma nasuta; shrimp - Pandalus platyceros; fish - Parophrys vetulus) were exposed to an urban estuarine sediment (16 ppm of two to six benzenoid ring aromatic hydrocarbons - AHs) to which trace amounts of H3-benzo(a)pyrene (BaP) were added. The techniques used to assess uptake and metabolism of AHs were gas chromatography/mass spectrometry (GC/MS) for AHs; high-pressure liquid chromatography/fluorescence spectrometry for AH metabolites in fish bile, and radiometric analyses for biotransformation of H3-BaP. Generally, the extent of metabolism of H3-BaP (M. nasuta < E. washingtonianus < R. abronius < or = P. platyceros = or equivalent to P. vetulus) was negatively correlated to tissue concentrations of AHs (three to six ring), except that amphipod species accumulated higher concentrations of AHs than did clams, indicating that other factors (e.g., feeding strategy and rate of excretion) also influenced accumulation of AHs. Radiometric and GC analyses for BaP in both sediment and tissues suggested that not all of the BaP (and presumably other AHs) extracted chemically from sediment was bioavailable. (Geiger - PTT)
W86-04143

VARIABILITY OF ALUMINUM CONCENTRATIONS IN ORGANS AND WHOLE BODIES OF SMALLMOUTH BASS (MICROPTERUS DOLOMIEUD),
Columbia National Fisheries Research Lab., MO.
W. G. Brumbaugh, and D. A. Kane.
Environmental Science and Technology ESTHAG, Vol. 19, No. 9, p 828-831, September 1985. 6 tab, 20 ref.

Descriptors: *Bass, *Water pollution effects, *Absorption, *Aluminum, *Bioaccumulation, *Spectrophotometry, Fish, Metals, Fish populations, Pollutant identification, Acidic water, Ecological effects, Hydrogen ion concentration, Biological samples, Error analysis, Atomic absorption spectrophotometry.

High soluble concentrations of metals in lakes and streams are often associated with low pH levels as a result of the mobilization or dissolution from sediments or terrestrial soils. Bioaccumulation of contaminants is often used as an indicator of the health of fish populations and is usually measured in whole-body fish. The primary objective in the present study was to ascertain potential field and analytical sources of variability and error when whole-body fish samples are analyzed for Al. Variability of Al concentrations in smallmouth bass was evaluated by analysis with graphite furnace atomic absorption spectrophotometry. Fish analyzed as whole bodies were compared to fish which had selected organs analyzed individually and separately from the carcass. Gastrointestinal tract contents contained highly variable amounts of Al and caused bias and increased variability when included in whole-body samples. Since Al concentrations in tissues of stomach and intestine were similar to those in the whole-body (less gastrointestinal tract contents), the entire gastrointestinal tract and contents could be removed to reduce bias and variability without measurably altering the true whole-body Al concentrations. Of the organs analyzed, gill filaments had the highest and most variable Al concentrations and may have contributed to within-fish whole-body variability because of incomplete homogenization. (Geiger - PTT)
W86-04144

EFFECT OF ELECTROPLATING FACTORY EFFLUENT ON THE GERMINATION AND GROWTH OF HYACINTH BEAN AND MUSTARD,
Aligarh Muslim Univ. (India). Environmental Research Lab.
M. Ajmal, and A. U. Khan.
Environmental Research ENVRAL, Vol. 38, No. 2, p 248-255, December 1985. 2 fig, 3 tab, 31 ref.

Descriptors: *Metal-finishing wastes, *Electroplating, *Water pollution effects, *Germination, *Heavy metals, Plant growth, Beans, Industrial wastes, Effluents, Ecological effects, Minerals, Calcium, Magnesium, Sodium, Potassium, Copper, Zinc, Iron, Electrolytes, Chromium, Nickel, Cobalt, Manganese, Lead, Absorption, Metals.

The effect of electroplating factory effluent in different concentrations (viz., 0.1, 0.2, 0.4, 0.6, 0.8, 1.0, 1.5, 2.0, 2.5, 3.0, and 4.0%) on the germination and growth of hyacinth beans (Dolichos lablab) and mustard seeds (Brassica compestris) was studied. The germination of seeds was delayed with the increase of effluent concentration and the germination of mustard seeds was totally inhibited at 1.5% effluent concentration while hyacinth bean seeds tolerated the effluent up to 2.4% concentration. The metal content in the hyacinth bean plants increased with increasing effluent concentration but after 1.0% effluent concentration, the concentration of all the metals (Ca, Mg, Na, K, Cu, Zn, Fe) decreased in the plants except Cr, which increased throughout. Percentage germination, fresh weight, dry weight, root length, and shoot length of the plants were also analyzed. Cd, Ni, Co, Mn, and Pb were not detectable in the hyacinth bean plants. (Author's abstract)
W86-04145

SUCCESSFUL ABATEMENT OF LEAD EXPOSURE FROM WATER SUPPLIES IN THE WEST OF SCOTLAND,
Glasgow Univ. (Scotland). Dept. of Medicine.
M. R. Moore, W. N. Richards, and J. G. Sherlock.
Environmental Research ENVRAL, Vol. 38, No. 1, p 67-76, October 1985. 2 fig, 3 tab, 36 ref.

Descriptors: *Water pollution effects, *Public health, *Lead, *Water distribution, *Water pollution control, Water pollution prevention, Water pollution treatment, Drinking water, Pipelines, Water mains, Acidic water, Hydrogen ion concentration, Blood, Scotland, Glascow, Ayr.

A major problem has existed in the West of Scotland for at least the past century associated with lead uptake by water from lead in water distribution systems. Initial studies in Glasgow from 1969 to 1976 and in Ayr in 1980/1981 showed that not only were water supplies soft, acid and in consequence highly plumbosolvent, and that water lead levels were, on average, unacceptably high but that blood lead concentrations were also in excess of acceptable limits. A decision was therefore made by Strathclyde Water Department to carry out remedial water treatment to adjust the water pH. The success of this venture was proven by the parallel rapid falls in blood lead and water lead concentrations in the city of Glasgow. This encouraged the Water Department to institute a similar scheme in the town of Ayr. Work on this commenced in 1981, and in a study of the participants in a previous blood lead survey, a highly significant fall in blood lead concentrations was observed. The equation linking these two parameters was found to follow a curvilinear relationship were blood lead varied as the cube root of the water lead with a highly significant coefficient of correlation. This relationship has been shown to hold across a wide range of water lead concentrations down to 1 microgram/liter. This detailed information allows accurate calculation of acceptable limits of lead exposure from specific sources based upon acceptable blood lead concentrations. (Author's abstract)
W86-04146

CHEMICAL CONTAMINATION OF WATER SUPPLIES,
North Carolina Univ. at Chapel Hill. School of Public Health.
C. M. Shy.
Environmental Health Perspectives EVHPAZ, Vol. 62, p 399-406, October 1985. 6 tab, 31 ref.

Descriptors: *Organic compounds, *Drinking water, *Water pollution effects, *Carcinogens, *Epidemiology, Public health, Water quality, Halogenated pesticides, Hydrocarbons, Ecological effects, Human pathology, Potable water.

Man-made organic chemicals have been found in drinking water for many years. Their numbers and varieties increase as our analytical capabilities improve. The identified chemicals comprise 10 to 20% of the total organic matter present. These are volatile or low molecular weight compounds which are easily identified. Many of them are carcinogenic or mutagenic. Chlorinated compounds have been found in untreated well water at levels up to 21,300 micrograms/liter and are generally present at higher levels in chlorine-treated water than in untreated water. Aggregate risk studies for cancer are summarized. The most common sites are: bladder, stomach, colon, and rectum. Such studies cannot be linked to individual cases. However, they are useful for identifying exposed populations for epidemiologic studies. Five case-control studies were reviewed, and significant associations with water quality were found for: bladder cancer in two studies, colon cancer in three and rectal cancer in four. A large study by the National Cancer Institute found that there had been a change in the source of raw water for 50% of the persons in one area between the years 1955 and 1975. Such flaws in the data may preclude finding a causal relation between cancer and contaminants in drinking water. Large case-control and cohort studies are needed because of the low frequency of the marker diseases, bladder and rectal cancer. Cohort studies may be precluded by variations in the kinds of water contaminants. Definitive questions about these issues are posed for cooperative effort and resolution by water chemists, engineers, and epidemiologists. (Author's abstract)
W86-04147

FROM PHYTOPLANKTON TO DETRITUS AND BACTERIA: EFFECTS OF SHORT-TERM NUTRIENT AND FISH PERTURBATIONS IN A EUTROPHIC LAKE,
Oslo Univ. (Norway). Biologisk Inst.
D. O. Hessen, and J. P. Nilssen.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 273-284, January 1986. 5 fig, 3 tab, 29 ref.

Descriptors: *Eutrophic lakes, *Phytoplankton, *Bacteria, *Detritus, Fish, Population dynamics, Roach, Algal biomass, Eutrophication, Rotifers, Zooplankton, Food chains.

Enclosure experiments in the eutrophic Lake Gjersjoen, Norway, showed that the presence of pre-adult planktivorous roach (Rutilus rutilus) more or less eliminated the crustacean zooplankton, especially daphniids, bosminids and advanced stages of copepods, whereas the density of rotifers increased. Analyses of gut content from roach captured in the lake showed the same predation pattern. The combination of roaches and excess nutrients, gave rise to a strong increase in phytoplankton and bacterial biomass. In bags with Daphnia and no fish present, the algal biomass was checked due to grazing, even when nutrients were available. The maintenance of high nutrient levels in such bags could also be due to increased recycling through herbivorous zooplankton. The detritus component increased where fish were present. A large pelagic population of fish in eutrophic lakes, eliminates large sized zooplankton, resulting in more energy being diverted through the detritus food-chain, instead of the more efficient grazer food-chain. (Lantz-PTT)
W86-04180

ALGAL ECOLOGY OF DEEPWATER RICE-FIELDS IN THAILAND,
Durham Univ. (England). Dept. of Botany.
B. A. Whitton, and H. D. Catling.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 289-297, January 1986. 2 fig, 1 tab, 9 ref.

Descriptors: *Rice fields, *Ecology, *Algae, *Thailand, Water chemistry, Diatoms, Seasonal distribution, Flood irrigation, Nitrogen fixing bacteria, Cyanophyta, Chlorophyta.

An account is given of changes in water chemistry and algal vegetation in one Thailand deepwater rice field (Huntra) through the 1983-1984 flood season, together with comparative observations with two other sites in September 1982. The Huntra field had standing water for almost six months (July-January), reaching a maximum depth of 175 cm in late October. The attached algal vegetation was dominated by heterocystous species of blue-green algae throughout the period, suggesting the importance of nitrogen fixation. The most abundant genera were Nostoc, Gloetrichia, Aulosira and Anabaena (in decreasing order). Green algae were the next most important phylum, with Bulbochaete and Oedogonium predominant. Diatoms showed an obvious increase in abundance in October, but even then formed a small part of the algal biomass in comparison with blue-green and green algae. The algal vegetation at two other sites, including one on acid sulphate soil, had a quite similar algal vegetation, in spite of obvious differences in water chemistry. Azolla pinnata reached a density of 223 individuals/sq m at one site, but was absent at the other two sites. (Lantz-PTT)
W86-04181

REGULATING FACTORS OF THE CONCENTRATION OF DISSOLVED CARBOHYDRATES IN A CENTRAL WATER COLUMN OF LAKE SUWA, JAPAN,
Yamagata Univ. (Japan). Dept. of Chemistry.
For primary bibliographic entry see Field 2K.
W86-04182

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 1. DYNAMICS OF PRODUCTION AND POPULATION OF THE PHYTOPLANKTON IN DEPENDENCE ON NUTRIENTS (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 1. PRODUCTIONS- UND POPULATIONSDYNAMIK DES PHYTOPLANKTONS IN ABHANGIGKEIT VOM NAHRSTOFFANGEBOT),
Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
V. N. Schilling, M. Schowalter, A. Peuker, M. Senser, and P. Wolf.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 329-343, January 1986. 7 fig, 1 tab, 26 ref.

Descriptors: *Limnology, *Lake Kochel, *Nutrients, *Phytoplankton, *Population dynamics, Lake morphology, Eutrophic lakes, Loisach River, Biomass, Algae, Silicon, West Germany.

The annual productivity of the phytoplankton (186 g C/sq m) in Lake Kochel, is lower than normally found in eutrophic lakes. However, it must be taken into consideration, that the water temperatures in Lake Kochel remain very low over the whole year and the high concentration of suspended particles evoked by peak water discharges of the Loisach river reduces the Euphotic zone and shades the organisms. The vertical profiles of high productivity, however, exhibit clinograde curves, which are typical of eutrophic lakes. The phytoplankton population is eutrophic with respect to both composition and succession. The Bacillariophyceae (28 species) are dominant in biomass production. The second most important group of algae is the Cryptophyceae (4 species), which are always present in the lake, but markedly reduced during the spring and autumn blooms of Bacillariophyceae. 23 species of Chlorophyceae have been detected, but only one species of Chlamydomonas appeared in significant numbers in summer. Although 7 species of Cyanophyceae could be observed, these organisms were found in very low numbers. Nutrient experiments show, that their phytoplankton composition (and succession) in Lake Kochel is primarily regulated by the amount of silicon dissolved in the water. (see also W86-04184) (Lantz-PTT)
W86-04183

LIMNOLOGY OF A SUBALPINE LAKE WITH A HIGH THROUGH FLOW RATE (LAKE KOCHEL): 2. SEASONAL, VERTICAL AND HORIZONTAL DISTRIBUTION OF BACTERIA (ZUR LIMNOLOGIE DES STARK DURCHSTROMTEN SUBALPINEN KOCHELSEES: 2. SAISONALE, VERTIKALE UND HORIZONTALE VERTEILUNG DER BAKTERIEN),
Bayerische Landesanstalt fuer Wasserforschung, Wielenbach (Germany, F.R.).
V. N. Schilling, H. Kropp, and R. Hilpert.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 3, p 345-353, January 1986. 4 fig, 2 tab, 19 ref.

Descriptors: *Limnology, *Lake Kochel, *Bacteria, *Seasonal distribution, *Lake morphology, Thermal stratification, Bacterial growth, Enteric bacteria, West Germany, Population dynamics, Loisach River.

The autochthonous growth of bacteria in Lake Kochel is superceded by the allochthonous input of bacteria from the Loisach River. The highest proportions of the number of colonies to that of total bacteria (0.11-0.20) were also always determined for this depth region. This quotient is considerably smaller (0.02-0.06) in the hypolimnion, which thus appears to constitute an essentially isolated body of water. Enterobacteriaceae and Enterococcae, which are indicative of fecal pollution, also evidence a pronounced clinograde distribution. Fecal bacteria can however only be detected in low concentration at the lake outlet (Coliform = 300 organisms x 100/ml; Enterococcae = 124 organisms x 100/ml). (see also W86-04183) (Lantz-PTT)
W86-04184

STUDIES ON THE POPULATION DYNAMICS OF GAMMARUS TIGRINUS SEXTON (CRUSTACEA: AMPHIPODA) IN THE RIVER WESER NEAR BREMEN(UNTERSUCHUNGEN ZUR POPULATIONSDYNAMIK VON GAMMARUS TIGRINUS SEXTON (CRUSTACEA: AMPHIPODA) IN DER WESER BEI BREMEN),
Bremen Univ. (Germany, F.R.).
V. E. Hackstein, M. Schirmer, and H. Liebsch.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 443-458, February 1986. 7 fig, 7 tab, 21 ref.

Descriptors: *Population dynamics, *Crustaceans, *Weser River, *Temperature effects, *Cadmium, Water pollution effects, Growth stages, Growth, Thermal pollution.

The population dynamics of Gammarus tigrinus SEXTON in the river Weser were studied over a period of 12 months. Lifespan of generations, length, weight, praecopulae, number of eggs per female and cadmium burden were measured and their dependence on temperature was tested. In 1981/1982 four generations of G. tigrinus were born in the river Weser. Temperature appears to influence growth rate, time to reach maturity and lifespan. If temperatures are elevated, G. tigrinus reaches maturity with less length and weight. The number of eggs per female depends on length. Cadmium burden depends on temperature and length of Gammarids: high temperatures are correlated with a small cadmium burden and juveniles carry a higher cadmium burden than adults, perhaps as a consequence of different food. (Lantz-PTT)
W86-04186

DIMENSIONAL DIFFERENTIATION BETWEEN FIVE PLANKTONIC ORGANISMS LIVING IN TWO AREAS CHARACTERIZED BY DIFFERENT SALINITY CONDITIONS,
Athens Univ. (Greece). Zoological Lab. and Museum.
M. Moraitou-Apostolopoulou, G. Verriopoulos, and N. Tsipoura.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 459-469, February 1986. 2 fig, 4 tab, 22 ref.

Descriptors: *Dimensional analysis, *Plankton, *Saline water, *Water pollution effects, Marine animals, Gastropods, Copepods, Cladocera, Saronicos Gulf, Amvrakicos Gulf, Greece.

Dimensional variations whether they occur seasonally or geographically have been observed in many species of marine invertebrates. These variations have been largely attributed to the differing conditions of various environmental factors, primarily temperature, food, or pollution conditions. Salinity has also been referred to as an environmental factor which can influence body size. Thus in the gastropod Neritina, dwarfs have been observed in the lowest and highest salinities encountered over the distributional range of this animal. In laboratory experiments body size has also been shown to be a function of salinity. Comparative measurements of three dimensional characters were realized in five planktonic organisms from two marine areas characterized by different salinity conditions. The five studied organisms were Acartia clausi, Centropages kroyeri (Copepoda) and Pneilia avirostris, Evadne spinifera and Evadne tergestina (Cladocera). The two collection areas were: a) Saronicos Gulf, and b) Amvrakicos Gulf, a semi closed bay where the discharge of two rivers significantly lowers the salinity. All measured dimensional characters of the five organisms were lower in Amvrakicos Gulf. The multilinear regression analysis proved that salinity and temperature are important factors for the formation of body length while phytoplankton quantity is of minor importance. Due to the strong salinity differences of the two Gulfs, it was concluded that the decreased body dimensions of the organisms living in Amvrakicos Gulf is mainly related to salinity. (Lantz-PTT)
W86-04187

INVESTIGATIONS ABOUT THE FATE OF HEAVY METALS IN LAKES: 1. THE ROLE OF FERROUS OXIDIZING BACTERIA TO COPRECIPITATION OF HEAVY METALS (UNTERSUCHUNGEN ZUM VERHALTEN VON SCHWERMETALLEN IN GEWASSERN: 1. DIE BEDEUTUNG EISENOXIDIERENDER BAKTERIEN DUR DIE KOPRAZIPATION VON SCHWERMETALLEN),
Technische Univ. Berlin (Germany, F.R.). Inst. fuer Technischen Umweltschutz.
For primary bibliographic entry see Field 5B.
W86-04188

ENERGY FLOW IN THE POPULATIONS OF EUDIAPTOMUS GRACILOIDES AND DAPHNIA GALEATA IN LAKE ESROM,
Copenhagen Univ., Hilleroed (Denmark). Det Ferskvands-Biologiske Lab.
K. Hamburger.
Archiv fur Hydrobiologie AHYBAY, Vol. 105, No. 4, p 517-530, February 1986. 4 fig, 1 tab, 25 ref.

Descriptors: *Energy transfer, *Population dynamics, *Eudiaptomus graciloides, *Daphnia galeata, Lake Esrom, Denmark, Biomass, Respiration, Seasonal variation, Phytoplankton, Foods.

The energy flow in two populations of planktonic crustaceans in eutrophic Lake Esrom, Denmark, was investigated. Two species, the calanoid copepod, Eudiaptomus graciloides and the daphnid, Daphnia galeata, account for 90% of the crustacean biomass and about 80% of the total zooplankton biomass. The energy flow was calculated as the sum of the energy in biomass respiration and the energy of the production, based on previous investigations of population dynamics and production in conjunction with respiration measurements on animals reared in the laboratory. In both populations the energy flow reached a maximum at the time when the phytoplankton spring bloom was over and the phytoplankton production had reached a minimum. These changes in ambient food concentration were reflected on the net production efficiency (K sub 2). K sub 2 varied greatly with the season, with maximum in May and minimum in July. The respiratory expenditures are discussed in relation to the ambient food concentration. It is concluded that the annual assimilation in the population of E. graciloides was between 258 and 320 kcal/sq m of which the production amounted to 65 kcal/sq m. For the population of D. galeata the corresponding values were 277 to 350 kcal/sq m and 120 kcal/sq m. Altogether the planktonic crustaceans in Lake Esrom assimilated between 27 and 33% of the gross phytoplankton production out of which 9% went on to higher trophic levels. (Lantz-PTT)
W86-04189

WASTE TREATMENT/DISPOSAL SITE EVALUATION PROCESS FOR AREAS UNDERLAIN BY CARBONATE AQUIFERS,
Minnesota Pollution Control Agency, Roseville.
For primary bibliographic entry see Field 5G.
W86-04219

EFFECTS OF EXPOSURE TO SALTY DRINKING WATER IN AN ARIZONA COMMUNITY: CARDIOVASCULAR MORTALITY, HYPERTENSION PREVALENCE, AND RELATIONSHIPS BETWEEN BLOOD PRESSURE AND SODIUM INTAKE,
Centers for Disease Control, Atlanta, GA. Div. of Chronic Disease Control.
T. k. Welty, L. Freni-Titulaer, M. M. Zack, P. Weber, and J. Sippel.
Journal of the American Medical Association, Vol. 255, No. 8, p 622-626, February 7, 1986. 1 fig, 5 tab, 24 ref.

Descriptors: *Saline water, *Water pollution effects, *Drinking water, *Blood pressure, *Sodium, Gila Bend, Arizona, Papago Indians, Potable water, Physiology.

A high level of sodium (440 mg/L) in the water supply of Gila Bend, Arizona, caused concern because of apparently elevated rates of hypertension in Gila Bend Papago Indians. Surveyed were 342 Gila Bend Papago Indians and 375 non-Indians from July to September 1983. Participants 25 years of age and older were interviewed for health risk factors, water consumption, and dietary sodium and calcium intake and had height, weight, blood pressure, and urinary sodium and potassium levels measured. Although this study did not provide any evidence of a positive association between blood pressure and water sodium intake, it was not designed to evaluate the effect of the high drinking-water sodium level on hypertensive patients, cardiac patients, or persons who are genetically sensitive to sodium intake. Drinking water high in sodium has been reported as an unsuspected cause of cardiac decompensation. Mean blood pressures for the Gila Bend whites were lower in most age groups than in comparison US white populations. The prevalence rates of hypertension in Gila Bend were not significantly higher than the national rates. (Lantz-PTT)
W86-04223

KINETICS OF ALUMINUM FLUORIDE COMPLEXATION IN ACIDIC WATERS,
Maine Univ. at Orono. Dept. of Chemistry.
For primary bibliographic entry see Field 5B.
W86-04226

REACTIONS OF FISH TO MICROORGANISMS IN WASTEWATER,
Technion - Israel Inst. of Tech., Haifa. Sherman Center for Research in Environmental and Water Resources Engineering.
N. Buras, L. Duek, and S. Niv.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 989-995, October 1985. 13 tab, 18 ref.

Descriptors: *Fish Ponds, *Wastewater Reuse, *Microbiological Studies, Fish Physiology, Bacterial Analysis, Bacteriophage, Polio Virus, Carp, Tilapia.

Carp and tilapia were inoculated with various microorganisms (bacteria, bacteriophage, and polio virus) present in wastewater. A threshold concentration was determined over which these microorganisms were recovered from the muscles. The threshold concentrations were different for bacteria, bacteriophages, and polio 1 LSc virus. The threshold values were lower when fish were inoculated than when they were immersed in water containing these organisms. Depuration experiments were efficient when the fish did not contain high concentrations of bacteria in their muscles. As the threshold concentrations are an expression of the capability of the immune system of the fish, these values can be useful for the design and management of fishponds in which treated wastewater is used. (Author's abstract)
W86-04236

EFFECT OF COMMERICAL FORMULATION OF FOUR ORGANOPHOSPHORUS INSECTICIDES ON THE OVARIES OF A FRESHWATER TELEOST, MYSTUS VITTATUS (BLOCH) - A HISTOLOGICAL AND HISTOCHEMICAL STUDY,
Banaras Hindu Univ., Varanasi (India). Dept. of Zoology.
S. Haider, and N. Upadhyaya.
Journal of Environmental Science and Health JPFCD2, Vol. B20, No. 3, p 321-340, June 1985. 14 fig, 1 tab, 33 ref.

Descriptors: *Organophosphorus insecticides, *Insecticides, *Fish, *Pesticide Toxicity, Fish Physiology, Toxicity, Organic Pesticides, Phosphorus Compounds.

The chronic effect of an exposure to a sublethal concentration of commercial formulation of 4 organophosphorus insecticides, (OPI), birlane (chlorfenvinphos), gardona (tetrachlorvinphos), phosdrin (mevinphos) and malathion, on midvitellogenic ovaries of 50 Mystus vittatus was investigated using histological and histochemical techniques. The loss of stage II and III oocytes accompanied by a significant decline in gonadosomatic index was recorded. The occurrence of only stage I oocytes in OPI-treated M. vittatus indicates that there was no vitellogenesis. The RNA content of remaining stage I oocytes of exposed fishes resembled that of the stage I oocytes of the control fishes. The absence of delta 5-3 beta-hydroxysteroid dehydrogenase suggests the lack of steroidogenesis. Reduced glucose-6-phosphate dehydrogenase (G-6-PD) activity was also observed. The occurrence of G-6-PD in follicular cells of OPI-treated fish oocytes may suggest the presence of an active mixed function oxidase system requiring nicotine-amide adenine dinucleotide phosphate. However, the role of follicular cells in biotransformation of OPI needs further study. (Peters-PTT)
W86-04238

INFLUENCE OF DEEP OCEAN SEWAGE OUTFALLS ON THE MICROBIAL ACTIVITY OF THE SURROUNDING SEDIMENT,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
For primary bibliographic entry see Field 5E.
W86-04257

INHIBITION OF BRAIN ACHE IN BROOK TROUT BY AMINOCARB AND ITS TOXIC METABOLITES,
Forest Pest Management Inst., Sault Sainte Marie (Ontario).
S. Y. Szeto, K. M. S. Sundaram, and J. Feng.
Journal of Environmental Science and Health JPFCD2, Vol. B20, No. 5, p 559-579, October 1985. 2 fig, 1 tab, 21 ref.

Descriptors: *Insecticides, *Trout, *Fish Physiology, *Pesticide Toxicity, Aminocarb, Metabolites, Toxicity, Aerial Spraying.

In vitro inhibitions of brain AChE in brook trout, Salvelinus fontinalis, by aminocarb (4-dimethylamino-m-tolyl N-methylcarbamate) and its toxic metabolites, MAA (4-methylamino-m-tolyl N-methylcarbamate), AA(4-amino-m-tolyl N-methylcarbamate), MFA (4-methylformamido-m-tolyl N-methylcarbamate) and FA(4-formamido-m-tolyl N-methylcarbamate) were investigated. The molar concentrations of inhibitors causing 50% inhibition were AA (3.62 x 10 to the minus 6th power) < MAA (7.92 x 10 to the minus 6th power) < aminocarb (1.01 x 10 to the minus fifth power) < MFA (4.29 x 10 to the minus fifth power) < FA (7.11 x 10 to the minus fifth power). After exposure of fish to various concentrations of aminocarb (25, 250 and 2500 ppb) and MAA (25, 250, 500 and 2500 ppb) at 9 C in dechlorinated tap water for 96 hr, inhibitions of brain AChE ranged from 13 to 77%. Mortality occurred only in fish exposed to 500 ppb (8 of 36 fish) and 2500 ppb (all 36 fish) of MAA. Enzyme activities recovered to the control levels 12 to 96 hr after the fish had been transferred to clean water for clearing; in survivors of the 500-ppb MAA exposure, however, AChE activities decreased again thereafter. Since MAA has never been detected in natural water after aerial spray and tissue residues of MAA can be eliminated rapidly in fish, it is concluded that any adverse effect of brain AChE due to MAA as a result of aerial sprays would be very unlikely. (Peters-PTT)
W86-04261

POTENTIAL HEALTH IMPLICATIONS FOR ACID PRECIPITATION, CORROSION, AND METALS CONTAMINATION OF DRINKING WATER,
Pennsylvania State Univ., University Park. School of Forest Resources.
W. E. Sharpe, and D. R. DeWalle.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 71-78, November 1985. 6 fig, 1 tab, 10 ref.

Descriptors: *Drinking water, *Acid rain, *Corrosion, *Water pollution sources, *Metals, Water pollution effects, Cisterns, Surface waters, Ryznar Index, Copper, Lead.

Potential health effects of drinking water quality changes caused by acid precipitation are presented. Several different types of water supplies are and their roles in modifying acid rain impacts on drinking water are explained. Sources of metals contamination in surface water supplies and some results from previous research into acid rain impacts on roof-catchment cisterns, small surface water supplies, and lead mobilization in acid soils are discussed. A good correlation was obtained between cistern water corrosivity as measured by the Ryznar Index (RI) values and standing tapwater copper concentrations. However, lead concentrations in tapwater did not correlate well with cistern water RI. A modified linear regression model that accounted for Ryznar Index change during storage in vinyl-lined cisterns, was used to predict

the Ryznar Index value at a copper concentration of 1000 micrograms/l. The predicted RI was greater than the RI of precipitation with a pH of 5.3, indicating that anthropogenically acidified precipitation may result in cistern tapwater copper concentrations in excess of the 1000 micrograms/l suggested drinking water limit. Good correlations between tapwater Ryznar Index and tapwater copper and lead concentrations were not obtained for the small surface water supply. Aluminum concentrations in reservoir water were similar to those in stream source water. Limited data were also presented that indicated lead was present in acid forest soil leachate and streams draining such soils in relatively small concentrations. Where appropriate, recommendations for future research are included with the discussion of research results. (Lantz-PTT)
W86-04264

EFFECTS OF ACIDIFICATION ON METAL AVAILABILITY TO AQUATIC BIOTA, WITH SPECIAL REFERENCE TO FILAMENTOUS ALGAE,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
P. M. Stokes, R. C. Bailey, and G. R. Groulx.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 79-87, November 1985. 10 fig, 3 tab, 27 ref.

Descriptors: *Acidic water, *Metals, *Aquatic biota, *Algae, *Acid rain, Stress, Toxicity, Zinc, Lead, Aluminum, Mercury, Water pollution effects, Nickel, Copper, Ontario, Quebec, Hydrogen ion concentration, Manganese, Pollution load.

A survey of 34 shield lakes in Ontario and Quebec, pH 4.4 to 7.1, was made to evaluate which metals should be considered of concern as a risk to aquatic biota or consumers when lakes are acid stressed. A set of predictions, concerning the mobilization by man, the mobility, the chemical speciation, and the toxicity or bioaccumulation of metals in acid-stressed waters, were used as a basis for designing the study and organizing the results. Attached algae were used as biomonitors to assess metal bioavailability. Zinc, manganese and aluminum increased as pH decreased; zinc and aluminum have reached potentially toxic concentrations in the surface waters surveyed, while manganese which is much less toxic has not. Zinc accumulation in algae decreased at low pH, even though the concentration of zinc increased, while manganese in algae showed a trend towards increasing at low pH. Aluminum in algae did not follow any pattern, but there may be technical problems. Copper and nickel in water increased as pH decreased, and algal copper and nickel both increased as pH decreased or metal increased. These relationships were, however, driven by the factor of local loadings of nickel and copper from a smelter complex. Lead in water showed no relationship with pH, but algal lead tended to increase as pH decreased. Mercury was low to undetectable in surface waters, yet algal mercury showed a number of significant correlations, notably with dissolved ions (negative), dissolved carbon (positive), and fish mercury (positive). (Lantz-PTT)
W86-04265

ALUMINUM IN ACIDIC SURFACE WATERS: CHEMISTRY, TRANSPORT, AND EFFECTS,
Syracuse Univ., NY. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04267

POTENTIAL IMPACT OF ACID PRECIPITATION ON ARSENIC AND SELENIUM,
North Carolina Univ. at Chapel Hill. Dept. of Pathology.
P. Mushak.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 105-113, November 1985. 2 fig, 58 ref.

Descriptors: *Acid rain, *Environmental effects, *Arsenic, *Selenium, Drinking water, Acidic water, Groundwater pollution, Water pollution effects, Soil chemistry, Hydrogen ion concentration.

The potential impact of acidic precipitation on the environmental mobility of the metalloids arsenic (As) and selenium (Se) has not been given much attention and is poorly understood. As with other elements, the interest here is the potential effect of environmental acidification on environmental behavior in ways that are relevant to human exposure to these metalloids. Available information on acid precipitation and the environmental behavior of these metalloids do, however, permit some preliminary conclusions to be drawn. Both As and Se appear to be mobilized from household plumbing into tap water by the corrosive action of soft, mildly acidic water, while surface water catchment systems in areas impacted by acidic deposition may contain elevated soluble As levels. Acidification of aquatic ecosystems that are drinking water sources may pose the prospect of enhanced release of As from sediment to water as well as reduction in water levels of Se. Acidification of groundwaters, where As appears to be especially mobile, is of particular concern in this regard. The potential impact of acidic deposition on As and Se in soils cannot readily be assessed with respect to human exposure, but it would appear that the behavior of these metalloids in poorly buffered, poorly immobilizing soils, e.g., sandy soils of low metal hydrous oxide content, would be most affected. The effect is opposite for the two elements; lowered pH would appear to enhance As mobility and to reduce Se availability. (Lantz-PTT)
W86-04268

EFFECTS OF ACIDIFICATION ON THE MOBILITY OF METALS AND METALLOIDS: AN OVERVIEW,
Minnesota Univ., Navarre. Gray Freshwater Biological Inst.
J. M. Wood.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 115-119, November 1985. 1 fig, 1 tab, 35 ref. NIH AM 18101.

Descriptors: *Acid rain, *Path of pollutants, *Metals, *Metalloids, Sediments, Soils, Acidic water, Aquatic biota, Environmental effects, Kinetics, Thermodynamics, Arsenic, Selenium, Mercury, Aluminum, Fish, Japan, China, Guam, Drinking water.

The exchange rates for metals and metalloids between sediments, soils, water and aquatic biota are discussed in terms of normal and acidified ecosystems. Where it is possible, the pathways for a number of toxic elements are presented with special emphasis on the impact of acidification on changing chemical speciation, and on the potential toxicity of such acid-generated chemical species. The pathways taken by each element involve many chemical species, and the distribution of these species is determined by thermodynamic and kinetic considerations. Those species which are stable thermodynamically can often be isolated and quantitated. Ideally the precise chemical structures of each of these stable compounds, or complexes, should be analyzed in that matrix where they exist naturally. Unfortunately, in the stressed system entropy increases and there is a concomitant increase in instability in both the physical and biological context. The acidification of the aqueous environment has already been shown to cause significant stress on ecosystems. As diversity of populations decrease to only a few acid tolerant species, then the normal balance for the cycling of elements changes appreciably. This has already been shown to be the case for mercury and aluminum, and may well be the case for the metalloids arsenic and selenium. The net effect of this instability is an increase in the concentration of methylmercury in predatory fish and an increase in the concentration of soluble aluminum species in surface waters. The consumption of methylmercury-contaminated fish has already been the cause of major health problems in Japan and more recently in China, and the consumption of drinking water containing high concentrations of aluminum is implicated in the epidemiology of Alzheimer's disease in Guam. (Lantz-PTT)
W86-04269

INFLUENCE OF ACID RAIN UPON WATER PLUMBOSOLVENCY,
Glasgow Univ. (Scotland). Dept. of Medicine.
M. R. Moore.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 121-126, November 1985. 3 fig, 1 tab, 36 ref.

Descriptors: *Acid rain, *Acidic water, *Plumbing, Lead, Hydrogen ion concentration, Closed-loop systems, Glasgow, Ayr, Scotland, Water pollution effects.

The West of Scotland has had particular problems in the past associated with soft acidic water supplies and uptake of lead from domestic plumbing systems by such water. As a consequence of this, health problems related to overexposure to lead have been identified. The current debate on acidification of ground waters by acid rain is therefore particularly pertinent to this area. Studies have shown that even a modest decrease in pH will result in very substantial increase in plumbosolvency. This was found to be of particular importance in the city of Glasgow and town of Ayr, where prior to water treatment, pH values were 6.3 and 5.4, respectively, and where, consequently, large numbers of homes did not comply with lead in water standards (that lead in water should only provide less than 10% of the overall daily exposure to lead). Closed-loop lime-dosing systems were introduced in both Glasgow and Ayr to increase the pH with an immediate decrease in the lead content of the water and, subsequently, blood lead concentrations of the subjects living in these areas. Such closed-loop systems will compensate for any acidity in water supplies, whether of natural origin or originating from acid rain precipitation. However, when such treatment has not been applied, any increase in water acidity due to acid rain will worsen a situation which is, in many cases, already unacceptable. (Lantz-PTT)
W86-04270

WATER CONTENT OF ALUMINUM, DIALYSIS DEMENTIA, AND OSTEOMALACIA,
Virginia Univ., Charlottesville. School of Medicine.
M. R. Wills, and J. Savory.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 141-147, November 1985. 52 ref.

Descriptors: *Aluminum, *Dialysis, *Water pollution effects, *Acid rain, Kidneys, Drinking water, Tissue analysis, Toxicity, Tissue accumulation, Osteomalacia.

A high concentration of aluminum in drinking water has been implicated as a factor in the etiology of a neurological syndrome in one specific geographical area. The role of aluminum as a toxic agent in other neurological disorders, where renal function is normal, is controversial. Aluminum is absorbed from the gastrointestinal tract and is normally excreted by the kidneys in the urine. In patients with chronic renal failure, aluminum appears to be of proven toxicological importance. In these patients the accumulation of aluminum in tissues causes an encephalopathy, a specific form of metabolic bone disease, and an anemia, and also plays an etiological role in some of the other complications associated with end-stage chronic renal failure. The majority of chronic renal failure patients who develop aluminum toxicity are on long-term treatment with either hemo- or peritoneal dialysis; some patients develop toxicity who are only on treatment with aluminum-containing phosphate-binding agents. Aluminum in the dialysate appears to be the major source of the metal in chronic renal failure patients who develop aluminum toxicity. The aluminum content of the dialysate depends primarily on the content of the water with which it is prepared; there may be some contribution from the chemicals used in the concentrate which is added to the water. Some domestic tap-water supplies contain aluminum in high concentration, either naturally or because aluminum has been added as a flocculant in the purification process. Acid rain markedly increases the 'natural' aluminum content in water. (Lantz-PTT)
W86-04271

HEALTH RISKS FROM ACID RAIN: A CANADIAN PERSPECTIVE,
Environmental Health Directorate, Ottawa (Ontario).
C. A. Franklin, R. T. Burnett, R. J.P. Paolini, and M. E. Raizenne.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 155-168, November 1985. 7 fig, 8 tab, 40 ref.

Descriptors: *Acid rain, *Environmental effects, *Canada, *Health risks, Long-Range Transport of Airborne Pollutants, Sulfur dioxide, Air pollution, Saskatchewan, Manitoba, Asthma, Copper, Lead, Water quality control.

Acid rain is causing serious environmental damage in eastern Canada. The revenues from forest products, tourism and sport fishing are estimated to account for about 8% of the gross national product. The impact on human health is not as clearcut and a multi-department program on the Long-Range Transport of Airborne Pollutants (LRTAP) was approved by the federal government in June 1980. The objectives of the LRTAP program are to reduce wet sulfate deposition to less than 20 kg/ha/yr in order to protect moderately sensitive areas. This will require a 50% reduction in Canadian SO2 emissions east of the Saskatchewan/Manitoba border and concomitant reductions in the eastern U.S.A. The objectives of the health sector of the program are to assess the risk to health posed by airborne pollutants which are subjected to long-range transport and to monitor the influence of abatement programs. Studies on the indirect effects of acid deposition on water quality have shown that acidified lake water left standing in the plumbing system can adversely affect water quality and that federally set guidelines for copper and lead are exceeded. Flushing of the system before using the water rectifies the situation. Additional studies are planned to further delineate the magnitude of the health effects of acidified lake water. (Lantz-PTT)
W86-04272

IMPACT OF EFFECTS OF ACID PRECIPITATION ON TOXICITY OF METALS,
Umea Univ. (Sweden). Dept. of Environmental Hygiene.
G. F. Nordberg, R. A. Goyer, and T. W. Clarkson.
Environmental Health Perspectives EVHPAZ, Vol. 63, p 169-180, November 1985. 1 tab, 79 ref.

Descriptors: *Acid rain, *Toxicity, *Metals, *Water pollution effects, Drinking water, Hydrogen ion concentration, Corrosion, Plumbing, Lead, Cadmium, Copper, Aluminum, Dialysis, Kidneys.

Human metal exposures via drinking water may be increased by acid precipitation. Decreasing pH increases corrosiveness of water enhancing the mobilization of metal salts from soil; metallic compounds may be mobilized from minerals, which may eventually reach drinking water. Also, the dissolution of metals (Pb, Cd, Cu) from piping systems for drinking by soft acidic waters of high corrosivity may increase metal concentrations in drinking water. Exposures have occasionally reached concentrations which are in the range where adverse health effects may be expected in otherwise healthy persons. Dissolution from piping systems can be prevented by neutralizing the water before distribution. Increased aluminum concentrations in water is a result mainly of the occurrence of Al in acidified natural waters and the use of Al chemicals in drinking water purification. If such water is used for dialysis in patients with chronic renal failure, it may give rise to cases of dialysis dementia and other disorders. A possible influence on health of persons with normal renal function (e.g., causing Alzheimers disease) is uncertain and requires further investigation. While all of the mentioned possibilities for increased metal exposures due to acid precipitation do exist, information that allows a quantitative estimation of their importance is almost entirely lacking and more research is needed. For an evaluation of the impact to human health of increased metal exposures, present knowledge about relationships between dose (or exposure) and the risk for adverse effects are reviewed. It is concluded that improved knowledge would be desirable for several of the metals discussed. Particularly, for an evaluation of possible adverse effects of aluminum in persons with normal renal function, present knowledge is inadequate and more research is needed. (Lantz-PTT)
W86-04273

MICROBIAL BIOMASS, ACTIVITY, AND COMMUNITY STRUCTURE IN SUBSURFACE SOILS,
Procter and Gamble Co., Cincinnati, OH. Ivorydale Technical Center.
T. W. Federle, D. C. Dobbins, J. R. Thornton-Manning, and D. D. Jones.
Ground Water GRWAAP, Vol. 24, No. 3, p 365-374, May-June 1986. 4 fig, 4 tab, 23 ref.

Descriptors: *Biomass, *Subsurface soils, *Microenvironment, *Soil contamination, Water pollution effects, Soil environment, Phospholipids, Fatty acids, Regression analysis, Statistical analysis.

Biomass and community structure were determined by analyzing the fatty acids of the extractable phospholipids, in four soil types common to Alabama. Activity was estimated by measuring the rate of enzymatic hydrolysis of fluorescein diacetate (FDA). In all four soils, biomass and activity declined with increasing depth; however, the magnitude and pattern of this decline varied as a function of soil type. Biomass concentrations in the lower Ap horizon ranged from 8.2 to 18.0 nanomoles phospholipid/g dry wt soil. In the deepest subsoil horizons, the range was 0.0085 to 0.059 nanomoles phospholipid/g dry wt soil. The rate of FDA hydrolysis was highly correlated with biomass ($r = 0.90$). Polyenoic fatty acids, which are present only in eukaryotic microorganisms, were found in all horizons. However, their relative abundance differed as a function of soil type. Stepwise regression analysis revealed that soil characteristics could explain 89 and 82% of the variation in biomass and activity, respectively. The results indicated that the vertical distribution of microorganisms in a soil profile differs greatly as a function of soil type. Hence, soil type may be an important determinant as to whether potential groundwater pollutants are biodegraded as they pass through the unsaturated zone of a soil profile. (Lantz-PTT)
W86-04281

INDUSTRIAL WASTES AND PUBLIC HEALTH: SOME HISTORICAL NOTES, PART I, 1876-1932,
Carnegie-Mellon Univ., Pittsburgh, PA.
For primary bibliographic entry see Field 5E.
W86-04327

EVALUATION OF CONVENTIONAL TREATMENT PROCESSES FOR REMOVAL OF MUTAGENIC ACTIVITY FROM MUNICIPAL WASTEWATERS,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5D.
W86-04330

PATHOMORPHOLOGICAL CHANGES IN GILLS OF FISH FINGERLINGS (CIRRHINA MRIGALA) BY LINEAR ALKYL BENZENE SULFONATE,
Industrial Toxicology Research Centre, Lucknow (India).
V. Misra, H. Lal, G. Chawla, and P. N. Viswanathan.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 302-308, December 1985. 3 fig, 17 ref.

Descriptors: *Gills, *Fish toxins, *Alkylbenzene sulfonate, *Fish physiology, Water pollution effects, Industrial wastewater, Environmental effects.

Synthetic detergents used in household cleaning have been shown to be toxic to fish and aquatic invertebrates. The foci of local action of detergents are the gills, gastrointestinal canal, and to a lesser extent the gonads. Gills, a primary site of osmoregulation and respiration, are the main targets for the aquatic toxicant, and is the most seriously affected organ. Presence of surfactants are known to cause destruction of the gill epithelium and reduction of the surface tension, and as a results many fish may die. The study focuses on the behavior pattern of fish as a primary indicator of toxicity as well as the impact of synthetic detergents on gills with the help of scanning electron microscopy. Fish fingerlings (Cirrhina mrigala) exposed to 0.005 ppm (25% of LC sub 50) concentration to detergents (linear alkyl benzene sulfonate) showed marked behavioral changes and distorted appearance of primary and secondary lamellae along with damage to gill epithelium under scanning electron microscopy at various magnifications. Mucosal cells of gills were found to secrete mucus showing primary reactions for membrane damage leading to dysfunction in respiration and osmoregulation. (Lantz-PTT)
W86-04357

TOXICOLOGY OF SELENIUM IN A FRESHWATER RESERVOIR: IMPLICATIONS FOR ENVIRONMENTAL HAZARD EVALUATION AND SAFETY,
Wake Forest Univ., Winston-Salem, NC. Dept. of Biology.
A. D. Lemly.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 314-338, December 1985. 13 fig, 5 tab, 63 ref.

Descriptors: *Toxicity, *Reservoirs, *Selenium, *Population exposure, *North Carolina, Fishkill, Fish toxins, Fish populations, Lakes, Tissue analysis, Fish behavior, Survival.

A study was conducted to document patterns of accumulation, and toxicity of selenium, to organisms in a power plant cooling reservoir in North Carolina. Selenium entered the reservoir by way of effluent from the coal ash disposal basin, which contained 100-200 micrograms Se/liter. Concentrations of selenium in the lake water averaged 10 micron g/liter, but were accumulated from 519 times (periphyton) to 3975 times (visceral tissue, largemouth bass) in the biota. The pattern and degree of accumulation was essentially complete within 2 years after the initial operation of the power plant, and persisted throughout the remainder of the study: fishes > insects > annelids > mollscs > crustaceans > plankton > periphyton. Of the 20 species of fish originally present in the reservoir, 16 were entirely eliminated, 2 were rendered sterile but persisted as adults, 1 was eliminated but managed to recolonize from a relatively uncontaminated headwater area as sterile adults, and 1 was unaffected. Two nonnative fish species were accidentally introduced and established reproducing populations. Abundance and diversity of biota other than fishes was not affected. Relative to control habitats, the contaminated reservoir had concentrations of waterborne selenium that were 20-30 times background levels; the flora and fauna contained about 10-15 times background. The results show that selenium can accumulate and be biologically magnified to toxic levels in a reservoir even though waterborne concentrations are in the low microgram per liter range. (Lantz-PTT)
W86-04358

AQUATIC TOXICITY EVALUATED USING HUMAN AND MONKEY CELL CULTURE ASSAYS,
Shimane Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
K. Mochida.
Bulletin oF Environmental Contamination and Toxicity BECTA6, Vol. 36, No. 4, p 523-526, April 1986. 1 fig, 1 tab, 7 ref.

Descriptors: *Toxicity, *Bioassay, *Cell lines, *Cadmium, *Zinc, *Copper, Heavy metals, River water, Diatoms, Rivers, Groundwater, Japan, Culturing techniques.

A cell culture assay is described in which cultures of the human established cell line KB and primary African green monkey kidney (AGMK) cells are

used to assess toxicity of river and ground water. With Cd, Cu, and Zn as model heavy metals, Cd was more toxic than Cu and Zn with both types of cultured cells. The present assay system was found to be more sensitive than one using diatoms. Samples of river and ground water from Japan (five sources of each) were not toxic in bioassays with either cell type (ie, percentage inhibition of growth never reached %5 in 5 monthly tests of each water source). (Rochester-PTT)
W86-04362

ACCUMULATION OF SEDIMENT-BOUND PCBS BY FIDDLER CRABS,
Environmental Research Lab., Gulf Breeze, FL.
For primary bibliographic entry see Field 5B.
W86-04365

ACUTE METAL TOXICOLOGY OF OLFACTION IN COHO SALMON: BEHAVIOR, RECEPTORS, AND ODOR-METAL COMPLEXATION,
Oregon State Univ., Corvallis. Dept. of Fisheries and Wildlife.
B. C. Rehnberg, and C. B. Schreck.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 579-586, April 1986. 2 fig, 2 tab, 16 ref. Sea Grant College Program NA81AA-D-00086.

Descriptors: *Mercury, *Copper, *Zinc, *Olefaction, *Odor-metal complexation, *Salmon, *Behavior, *Toxicity, Upstream movements, Metal-serine complexes, Juvenile salmon, Y-trough, Assay.

A behavioral assay of olfaction based on avoidance of L-serine in a two-choice Y-trough was employed in an attempt to determine the acute toxicities of Hg, Cu, and Zn to juvenile coho salmon (Oncorhynchus kisutch) olfaction. The detection of L-serine by juvenile coho salmon was inhibited by Hg and Cu, but not by Zn. None of the metals interfered with serine detection by formation of nonstimulatory metal-serine complexes. The mechanism of action of Cu remains unclear, whereas Hg appears to act at the level of the olfactory receptor. The likelihood of a fish swimming upcurrent into either Y-trough arm was depressed by the presence of Zh, Cu, or Hg. This depression of swimming behavior seemed to be related only to the presence of the metal, not to its concentration, because the smallest effects were seen at the highest metal concentrations. Zn had no observable effect on olfaction. The apparent decline in serine avoidance at 10(-7) Molar Zn probably resulted from small sample size. Avoidance of serine was inhibited at all test concentrations of Cu and Hg. (Rochester-PTT)
W86-04366

EFFECTS OF 1,2,4-TRICHLOROBENZENE ON ESTUARINE MACROBENTHIC COMMUNITIES EXPOSED VIA WATER AND SEDIMENT,
Environmental Research Lab., Gulf Breeze, FL.
M. E. Tagatz, G. R. Plaia, and C. H. Deans.
Ecotoxicology and Environmental Safety EESADV, Vol. 10, No. 3, p 351-360, December 1985. 1 fig, 5 tab, 14 ref.

Descriptors: *Trichorobenzene, *Estuaries, *Macrobenthic ecosystem, *Ecological effects, Water pollution effects, Sediments, Toxicity, Larvae, Mollusks, Arthropods, Annelids, Echinoderms, Population exposure.

Macrobenthic animal communities that colonized sand-filled aquaria were exposed to 1,2,4-trichlorobenzene (TCB), a recent replacement for polychlorinated biphenyls in the electrical industry. In one test, communities established by planktonic larvae entrained in continuously supplied unfiltered seawater for 50 days were exposed to waterborne TCB for 6 days. In the second test, the toxicant was added to the sediment before 8 weeks of colonization. Concentrations that affected community structure were usually two orders of magnitude lower for waterborne TCB than for sediment-bound TCB, but the same types of organisms were affected by each route of exposure. The lowest TCB concentrations (measured) that affected average numbers of individuals exposed via the water were 0.04 mg/l for mollusks, 0.4 mg/l for arthropods, and 4 mg/l for annelids. The average number of species was significantly lower than the control at 4 mg/l. The TCB exposures via the sediment, the lowest concentrations (nominal) that affected average numbers of individuals were 100 micrograms/gm for mollusks and echinoderms, and 1000 micrograms/gm for arthropods and annelids. The average number of species in experimental aquaria was significantly lower than the control at $>$ 100 micrograms/gm. TCB persisted in sediments, but some leached into water throughout the 8-week exposure via sediment. (Lantz-PTT)
W86-04398

EFFECTS OF THE HERBICIDE ATRAZINE ON AQUATIC INSECT COMMUNITY STRUCTURE AND EMERGENCE,
Kansas Univ., Lawrence. Museum of Natural History.
S. L. Dewey.
Ecology ECOLAR, Vol. 67, No. 1, p 148-162, February 1986. 8 fig, 3 tab, 73 ref, 1 append. EPA Grant No. CR808804-02-0.

Descriptors: *Atrazine, *Aquatic insects, *Ecological effects, Herbicides, Water pollution effects, Community structure, Experimental ponds, Macrophytes, Algae.

The herbicide atrazine was applied to 0.045-ha experimental ponds in two replicate concentrations of 0, 20, 100, and 500 micrograms/L each. Physical, chemical, and biological variables were measured and aquatic insect community structure was monitored in the eight ponds using partially submerged funnel emergence traps. Atrazine had no effect on water temperature or oxygen concentration. Mean turbidity did increase significantly with atrazine concentration, but turbidity could not be correlated with abundance or species richness of emerging insects. Macrophyte production decreased with increasing herbicide concentration; however, the macroalga Chara sp. showed resistance up to 100 microgram/L. The benthic insect community was also negatively affected by atrazine. Abundance of emerging individuals of the chironomid Labrundinia pilosella was significantly reduced at atrazine concentrations as low as 20 micrograms/L, while other, less abundant species showed similar declines. Benthic insect species richness (S), species equitability (J prime), and total emergence all declined significantly with atrazine addition. In general, abundances of nonpredatory insects were greatly reduced with the addition of atrazine (20 micrograms/L), while predatory insects showed no response to the herbicide. In addition, emergence periods of several herbivorous insect species shifted to an earlier time in atrazine-treated ponds; the shift was statistically significant for Oxyethira pallida. (Lantz-PTT)
W86-04401

EPIDEMIC CAMPYLOBACTERIOSIS ASSOCIATED WITH A COMMUNITY WATER SUPPLY,
Georgia Dept. of Human Resources, Atlanta.
J. J. Sacks, S. Lieb, L. M. Baldy, S. Berta, and C. M. Patton.
American Journal of Public Health AJHEAA, Vol. 76, No. 4, p 424-429, April 1986. 2 fig, 3 tab, 33 ref.

Descriptors: *Epidemics, *Campylobacteriosis, *Municipal water, *Water supply, Water quality, Water pollution sources, Water pollution effects, Bacteria, Birds, Campylobacter jejuni, Greenville, Florida.

In May 1983, an estimated 865 cases of epidemic gastrointestinal disease occurred in Greenville, Florida. Surveillance of pharmacy sales of antidiarrheal medicines suggested that the outbreak was confined to Greenville and its immediate vicinity. Surveys demonstrated that the gastrointestinal illness attack rates inside and outside the city limits were 56% (72/128) and 9% (7/77), respectively (relative risk (RR) = 6.2); consumption of city water was associated with illness (RR = 12); and as water consumption increased, the attack rate also increased ($p < 0.001$). Four adults were hospitalized and one outbreak-related case of Guillain-Barre' syndrome was identified. Campylobacter jejuni was isolated from specimens from 11 ill persons, with serologic studies showing the development of Campylobacter-specific antibodies. Fecal coliforms were found in water samples, but Campylobacter was not recovered from water. The city water plant, a deep well system, had numerous deficiencies including an unlicensed operator, a failure of chlorination, and open-top treatment towers. Birds were observed perching on the open-top treatment tower. Of 38 birds trapped seven weeks later, 37% harbored C. jenuni. However, plasmid and serotyping studies showed that strains were not the same as the common strain from ill persons. This outbreak suggests that water systems that are unprotected from contact with birds may become contaminated and a source of outbreaks of human campylobacteriosis. (Lantz-PTT)
W86-04403

GROUNDWATER QUALITY CHANGES RESULTING FROM A SURFACE BROMIDE APPLICATION TO A PASTURE,
Science and Education Administration, Coshocton, OH. North Appalachian Experimental Watershed.
For primary bibliographic entry see Field 5B.
W86-04419

TIME SCALES OF CATCHMENT ACIDIFICATION,
Virginia Univ., Charlottesville.
For primary bibliographic entry see Field 5B.
W86-04423

WATER HARDNESS AND CARDIOVASCULAR MORTALITY RATE IN ABRUZZO, ITALY,
Aquila Univ. (Italy). Faculty of Medicine.
V. Leoni, L. Fabiani, and L. Ticchiarelli.
Archives of Environmental Health AEHLAU, Vol. 40, No. 5, p 274-278, September/October, 1985. 1 fig, 4 tab, 30 ref.

Descriptors: *Water quality, *Mortality, *Cardiovascular disease, Abruzzo, Italy, Water hardness, Physiological effects, Nutrients, Water pollution effects.

For the years 1969-1978, the authors studied the pattern of mortality resulting from cardiovascular diseases (390-438 International Classification of Disease (ICD)), ischemic heart diseases (410-414 ICD), and cerebrovascular diseases (430-438 ICD), and then correlated mortality rate with water hardness. The study took place in the region of Abruzzo, Italy, which has a population of 594,323. The study found that: (1) an inverse correlation can be seen in relatively small non-metropolitan areas, but with the population uniformly distributed in relation to the 'hardness of water' variable. It was considered important that in those areas the differences in diet and lifestyles are negligible, and that the demand for food is almost exclusively provided for locally; and, (2) the inverse correlation can be seen despite the fact that the waters considered do not fall below 10 F of hardness, where an excessive mortality rate is clearly evident. Therefore, the 'soft water-hard arteries' hypothesis is strengthened with respect to the dose-effect relationship. (Lantz-PTT)
W86-04434

PCBS HAVE DECLINED MORE THAN DDT-GROUP RESIDUES IN ARCTIC RINGED SEALS (PHOCA HISPIDA) BETWEEN 1972 AND 1981,
Bedford Inst. of Oceanography, Dartmouth (Nova Scotia).
For primary bibliographic entry see Field 5B.
W86-04440

EFFICACY AND CHEMICAL PERSISTENCE OF TWO HIGHLY ACTIVE CARBAMATE DEVELOPMENTAL INHIBITORS,
California Univ., Parlier. Mosquito Control Re-

search Lab.
C. H. Schaefer, W. H. Wilder, E. F. Dupras, Jr., and R. J. Stewart.
Journal of Agricultural and Food Chemistry JAFCAU, Vol. 33, No. 6, p 1045-1048, November/December 1985. 9 tab, 8 ref. USDA Cooperative Agreement No. 82-CRSR-2-1010.

Descriptors: *Carbamates, *Insecticides, *Chemcontrol, *Mosquitos, Larvae, Tissue analysis, Mature growth stage, Water pollution effects, Fish, Temperature effects, Hydrogen ion concentration.

Ro16-1294, 2-(p-(m-chlorophenoxy)phenoxy)ethyl ethylcarbamate, and Ro16-1295, 2-(p(m-fluorophenoxy)phenoxy)ethylcarbamate, show very high efficacy against immature mosquitoes in laboratory and field trials. When mosquito larvae are exposed to either compound, there is no direct toxicity but mortality occurs in the pupal stage; at even lower doses, adults emerge from the pupal cases but are unable to leave the water surface and die there. These compounds are stable in water over a wide range of temperature and pH. Ro16-1294 appears to be lost from water by the effects of sunlight and adsorption onto organic matter. Fish accumulate Ro16-1294 from water into their tissues more than 300-fold the water concentration, but the residues steadily decline when exposed fish are placed in untreated water. The efficacy and chemical persistence properties of Ro16-1294 offer good potential for its use as a mosquito control agent. (Lantz-PTT)
W86-04465

PROSPECTIVE STUDY OF SWIMMING-RELATED ILLNESS: 1. SWIMMING-ASSOCIATED HEALTH RISK,
Toronto Univ. (Ontario). Dept. of Microbiology.
R. P. Seyfried, R. S. Tobin, N. E. Brown, and P. F. Ness.
American Journal of Public Health AJHEAA, Vol. 75, No. 9, p 1068-1070, September 1985. 2 tab, 23 ref.

Descriptors: *Swimming, *Waterborne disease, *Water pollution effects, *Public health, Statistical analysis, Epidemiology, Pseudomonas aeruginosa, Bacterial infections.

During the summer of 1980, both swimmers and nonswimmers were enlisted in a prospective epidemiological study to determine the relationship between swimming, water quality, and the incidence of illness. Results of 4,537 telephone follow-up interviews showed that crude morbidity rates were 69.6 per 1,000 swimmers versus 29.5 per 1,000 nonswimmers. There was little alteration in the symptom rates when they were adjusted for factors of sex, contact person, age, and swimming shortly before or after the interview. Swimmers who put their head under water were found to have higher rates of ear illness. This finding supports the results of an earlier investigation that demonstrated a relationship between ear infections and the presence of Pseudomonas aeruginosa in the water. The higher morbidity rates observed here among swimmers under the age of 20 have also been noted in other studies. Swimmers experienced respiratory ailments most frequently, followed by gastrointestinal, eye, ear, skin, and allergenic symptoms, respectively. (See also W86-04467) (Lantz-PTT)
W86-04466

PROSPECTIVE STUDY OF SWIMMING-RELATED ILLNESS: 2. MORBIDITY AND THE MICROBIOLOGICAL QUALITY OF WATER,
Toronto Univ. (Ontario). Dept. of Microbiology.
P. L. Seyfried, R. S. Tobin, N. E. Brown, and P. F. Ness.
American Journal of Public Health AJHEAA, Vol. 75, No. 9, p 1071-1075, September 1985. 3 fig, 4 tab, 27 ref.

Descriptors: *Swimming, *Waterborne disease, *Water pollution effects, *Public health, Statistical analysis, Epidemiology, Coliforms, Streptococci, Pseudomonas aeruginosa, Staphlococci, Ontario.

Periodic closure of public beaches in North America has emphasized the need for the development of adequate microbiological standards for recreational waters. Current guidelines for fecal coliforms, the bacteriological indicator of choice in North America, vary by jurisdiction. In Ontario, Canada, the maximum limit is a geometric mean density of 100 fecal coliforms per 100 ml of water, where as in most other Canadian provinces and American states, the limit is 200 fecal coliforms per ml of water. A prospective cohort epidemiological-microbiological study was carried out at 10 beaches in Ontario, Canada. Lake water and sediment samples collected at the beaches were analyzed for fecal coliforms, fecal streptococci, heterotrophic bacteria, Pseudomonas aeruginosa, and total staphylococci. Mean fecal coliform levels in the surface water of the lakes were within accepted guidelines. Bacterial densities were found to be approximately 10 times higher in the sediment than in the corresponding surface water samples. Morbidity among swimmers was shown to be related to staphylococcal counts, to fecal coliform levels, and, somewhat less strongly, to fecal streptococcal counts. Total staphylococci appeared to be more consistent indicators for predicting total morbidity rates among swimmers. (See also W86-04466) (Lantz-PTT)
W86-04467

ENVIRONMENTAL ANALYSIS OF IRON-PRECIPITATING BACTERIA IN GROUND WATER AND WELLS,
Smith (S.A.) Consulting Services, Columbus, OH.
S. A. Smith, and O. H. Tuovinen.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 45-52, Fall 1985. 1 fig, 49 ref.

Descriptors: *Environmental effects, *Iron bacteria, *Groundwater, *Wells, Literature review, Aquifer characteristics, Public health, Biomass, Water analysis, Bacterial degradation, Corrosion.

Iron-precipitating bacteria are frequently cited as being involved in economically serious well and aquifer degradation that may also have a public health impact. The problems of bacterial degradation, clogging and corrosion in aquifers and wells is an old one that still persists on a geographical scale at least comparable to chemical pollution of groundwater. Conceptually, the current base of information and study methods to expand the data base greatly resemble the problems of monitoring and modeling chemical groundwater pollution. Quantifying the populations of the iron-precipitating bacteria present in groundwater is a complex problem not yet resolved. A survey of historical and modern environmental literature provides numerous descriptions of iron bacteria in aquifers and wells, along with physicochemical data collected during bacterial sampling. These data are not conclusively linked with iron bacteria occurrence. Iron bacteria is a concept encompassing may genera and species of bacteria with varying morphology and physiology. Methods to detect bacteria and to quantify bacterial biomass in aquifers are being developed, but representative sampling remains a problem. Predictive analysis of iron bacterial growth awaits additional physiological and sampling research. (Lantz-PTT)
W86-04470

BIOLOGICAL ACCUMULATION AND MONITORING OF CHEMICAL WASTES IN ARCTIC WATERS,
Solway Marine Investigations, Maryport (England).
For primary bibliographic entry see Field 5B.
W86-04475

ACCUMULATION OF AIRBORNE TRACE POLLUTANTS BY ARCTIC PLANTS AND SOIL,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 5B.
W86-04479

EFFECTS OF ENGINEERING CONTROLS ON METHANE FERMENTATION TOXICITY RESPONSE,
For primary bibliographic entry see Field 5D.
W86-04501

SEASONAL AND SPATIAL DISTRIBUTION OF BACTERIA, CHLOROPHYLL, AND NUTRIENTS IN NEARSHORE LAKE MICHIGAN,
Michigan Univ., Ann Arbor. Great Lakes Research Div.
For primary bibliographic entry see Field 2H.
W86-04526

RELATIONSHIPS BETWEEN CHLORINATED HYDROCARBON CONCENTRATIONS AND REARING MORTALITY OF CHINOOK SALMON (ONCORHYNCHUS TSHAWYTSCHA) EGGS FROM LAKE MICHIGAN,
Michigan State Univ., East Lansing. Dept. of Fisheries and Wildlife.
J. P. Giesy, J. Newsted, and D. J. Garling.
Journal of Great Lakes Research JGLRDE, Vol. 12, No. 1, p 82-98, 1986. 1 fig, 8 tab, 45 ref.

Descriptors: *Chlorinated hydrocarbons, *Chinook salmon, *Lake Michigan, Oncorhynchus tshawytscha, Water pollution effects, Polychlorinated biphenyls, Statistical analysis, Aroclor, Toxaphene, fish toxins, Fish physiology, Mortality.

A study was conducted to investigate a possible correlation between chlorinated hydrocarbon concentrations and rearing mortality of chinook salmon. Eggs, collected from adult Lake Michigan chinook salmon in October 1982, were analyzed for chlorinated hydrocarbon concentrations and rearing mortality. Polychlorinated biphenyls (PCB), toxaphene, and fifteen other chlorinated hydrocarbons were quantified. Also, concentrations of individual PCB congeners were quantified. We found 78 quantifiable PCB congeners, only three of which were non-ortho substituted. Mean concentrations of Aroclor 1242, 1254, and 1260 were 1.7, 5.4, and 1.1 micrograms/g, respectively. The concentration of toxaphene-like material was 3.3 micrograms/g, and the mean concentration of the total DDT complex was 1.0 micrograms/g. Concentrations of chlorinated hydrocarbons ranged approximately 10-fold among individual fish. An analysis of variance components demonstrated that this variability represented among-fish variation and was not due to errors in sampling or quantification. Duplicate studies of egg viability and fry mortality, conducted at 10, 11, and 15 C, correlated with residue concentrations. While some residue concentrations were significantly negatively correlated with egg viability and survival of fry, others were positively correlated. Thus, we observed no consistent trends in Pearson, pairwise-correlations between either egg viability or survival of fry to swim-up stage and individual residue concentrations. When the residues were classified into four principal components, two of the principal components which contained primarily the toxaphene and PCB concentrations were negatively correlated with survival of fry to the swim-up stage. (Author's abstract)
W86-04528

ALGAE REACTIONS TO MINERAL AND ORGANIC MICROPOLLUTANTS, ECOLOGICAL CONSEQUENCES AND POSSIBILITIES FOR INDUSTRIAL-SCALE APPLICATION: A REVIEW (REVUE DES REACTIONS DES ALGUES AUX MICROPOLLUTANTS MINERAUX ET ORGANIQUES; CONSEQUENCES ECOLOGIQUES ET POSSIBILITIES D'APPLICATIONS INDUSTRIELLES),
Societe Degremont, Rueil-Malmaison (France).
P. Mouchet.
Water Research WATRAG, Vol. 20, No. 4, p 399-412, April 1986. 1 fig, 5 tab, 121 ref.

Descriptors: *Algae, *Water pollution effects, *Organic compounds, *Industrial wastewater, *Minerals, Ecological effects, Chaetocurus calcitrans, Hydrocarbons, Phenols, Pesticides, Lagoons, Biologi-

cal degradation, Heavy metals, Polychlorinated biphenyls, Reviews.

An aquatic ecosystem may react to pollution in different ways, some of which combat the pollution actively; in particular, algae participate by developing various substances capable of complexing or degrading numerous organic or mineral pollutants. When heavy metals are not directly accumulated in algae, they can often be complexed by their extracellular metabolites, e.g. hydroxamates, to form organo-metallic compounds; the ecological consequences of these phenomena most often due to the presence of Cyanophyceae are varied. Organic micropollutants are often metabolized or even assimilated by algae. For example: Hydrocarbons are assimilated by marine algae such as the diatom Chaetoceros calcitrans, or by fresh water algae; Phenols are metabolized so far as to completely remove them through the action of phenoloxidases which induce the formation of transient degradation products, in particular quinones; Pesticides, which are most often accumulated in algae, are sometimes partially degraded by certain algae. However, this may results in the temporary appearance of metabolites more toxic than the initial product (e.g. DDE from DDT); and, PCBs which are so stable they are fixed without being metabolized, by living algae, and even dead ones. These various reactions show that in nature, certain algae prove specifically tolerant to various industrial wastes that contain mineral pollutants, or organic pollutants. These observations, made both in the laboratory and in the field, could well lead to new applications in the biological treatment of industrial waste water. Such possibilities have already been proved for vascular plants, such as for the removal of heavy metals or phenols. The new generation of biological treatments of industrial effluents will be based on selected algae species acting in symbiosis with bacteria in traditional lagooning or through more intensive processes, such as 'activated algae' or culture of algae immobilized in agar beads or on rotating discs. (Lantz-PTT)
W86-04568

EVALUATION OF MANAGEMENT ASPECTS OF A HYPERTROPHIC AFRICAN IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
For primary bibliographic entry see Field 5G.
W86-04569

SOURCES OF WATER TO THE SEAWATER WELL WHICH SUPPLIES THE FISH PONDS IN EILAT: IMPLICATIONS FOR FISHPOND MANAGEMENT,
National Mariculture Centre, Eilat (Israel).
For primary bibliographic entry see Field 5B.
W86-04576

SIMULATION OF WATER-BLOOM IN A EUTROPHIC LAKE - IV: MODELING THE VERTICAL MIGRATION IN A POPULATION OF MICROCYSTIS AERUGINOSA,
Tokyo Univ. of Agriculture and Technology (Japan). Dept. of Chemical Engineering.
M. Okada, and S. Aiba.
Water Research WATRAG, Vol. 20, No. 4, p 485-490, April 1986. 2 fig, 2 tab, 14 ref.

Descriptors: *Simulation analysis, *Eutrophication, *Lakes, *Model studies, *Vertical distribution, *Microcystis aeruginosa, Migration, Bluegreen algae, Algal colonies, Extinction coefficient, Mixing, Specific growth rate, Light intensity.

Simulation of the water-bloom dominated by Microcystis (blue-green algae) was carried out by modifying the mathematical model presented previously on the rising and sinking of the algal colonies through a still water column. In contrast to the earlier work on the simulation of single colonies, an overall behavior of many algal colonies, having not only the size distribution but also having distribution initially throughout the water column was simulated. The points of the model modified are (1) the specific growth rate was shown by a quadratic function of light intensity that takes the inhibitory effect into account and (2) the extinction coefficient incorporated the light-shielding effect by the algal cells existent depthwise in the water column rather than a linear function of the concentration of suspended materials in the water. The numerical solutions of the model (280 dimensions) were in agreement qualitatively with the observations ever reported on Microcystis behavior in eutrophic lakes. Factors relevant to the extinction coefficient underwater, i.e. the concentrations of either microcystis colonies or other suspended materials were significant from the viewpoint to control the algal growth as a whole, assuming that no nutrients specific growth rate especially when the concentrations of colonies or other materials were large. Consequently, an artifical aeration was suggested to be a commendable means to ward off the water-bloom. (Author's abstract)
W86-04579

BIOLOGICAL HALF-LIVES OF EIGHT POLYCYCLIC AROMATIC HYDROCARBONS (PAHS) IN RAINBOW TROUT (SALMO GAIRDNERI),
Canada Centre for Inland Waters, Burlington (Ontario).
A. J. Niimi, and V. Palazzo.
Water Research WATRAG, Vol. 20, No. 4, p 503-507, April 1986. 3 tab, 33 ref.

Descriptors: *Polycyclic aromatic hydrocarbons, *Rainbow trout, *Biological half-lives, Regression analysis, Statistical analysis, Phenanthrene, Fluorene, Anthracene, Fluoranthene, Benzo-a-pyrene, Benz-a-anthracene, Chrysene, Pyrene, Tissue analysis, Toxicity.

Adult rainbow trout were exposed to a single oral dose containing a mixture of eight polycyclic aromatic hydrocarbons (PAHs), and fish were sampled at intervals between 5-48 days after exposure. Regression analyses on whole fish indicate levels declined significantly in four of the compounds monitored. Their biological half-lives were estimated as 9 days for phenanthrene, 7 days for fluorene and anthracene and 6 days for fluoranthene. No reliable estimates could be derived for benzo(a)pyrene, bene(a)anthracene, chrysene or pyrene because of low or nondetectable concentrations at the first sample interval although it could be suggested that their half-lives would be less than several days. The data also suggested that these PAHs are poorly absorbed by trout. (Author's abstract)
W86-04582

DEVICE FOR THE CONTINUOUS MEASUREMENT OF ALGAL PHOTOSYNTHETIC RESPONSE TO LIGHT,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
C. L. Gallegos, and F. R. Schiebe.
Water Research WATRAG, Vol. 20, No. 4, p 509-516, April 1986. 5 fig, 35 ref.

Descriptors: *Continuous measurement, *Photosynthesis, *Algae, *Light intensity, *Light penetration, *Measuring instruments, Phytoplankton, Eutrophic waters, Water quality, Dissolved oxygen.

A device is described for continuously monitoring the photosynthetic response to light of phytoplankton in eutrophic waters. Water is pumped from the system being monitored, and flows in parallel into 8 chambers that are placed in a light gradient. Dissolved oxygen is measured periodically at the inflow and outflow of each chamber. Solution of the dynamic mass balance equation for a well mixed system provides an estimate of net photosynthetic oxygen evolution as a function of light intensity. The last chamber is darkened with opaque plastic thereby providing a continuous estimate of community dark respiration. The primary assumption made in the design of the system (complete mixing within the chambers) is verified by tracer studies. The utility of the system is demonstrated by comparison with in situ incubations, and by results of monitoring phytoplankton growth in turbid waters. (Author's abstract)
W86-04583

INTEGRATED ANALYSIS OF ACIDIFICATION IN EUROPE,
National Board of Waters, Helsinki (Finland). Water Research Inst.
For primary bibliographic entry see Field 5B.
W86-04589

SUMMARY OF WATERBORNE ILLNESS TRANSMITTED THROUGH CONTAMINATED GROUNDWATER,
Environmental Protection Agency, Cincinnati, OH.
G. F. Graun.
Journal of Environmental Health JEVHAH, Vol. 48, No. 3, p 122-127, November/December 1985. 4 fig, 12 tab, 2 ref.

Descriptors: *Groundwater pollution, *Water pollution effects, *Human diseases, *Drinking water, Water pollution sources, Viruses, Well water, Septic tanks, Disinfection, Fate of pollutants, Public health.

The use of contaminated, untreated or inadequately treated groundwater was responsible for 51% of all waterborne outbreaks and 40% of all waterborne illness reported in the United States during 1971-82. Contaminated, untreated or inadequately disinfected groundwater caused 65% of the waterborne outbreaks and 66% of the waterborne illness which occurred in noncommunity and individual water systems but only 32% of the outbreaks and 31% of illness in community water systems. Illnesses most frequently transmitted through groundwater included acute gastroenteritis of undetermined etiology, chemical poisonings, hepatitis A, shigellosis, and viral gastroenteritis. Waterborne outbreaks in water systems using untreated well water were caused primarily by the overflow of seepage of sewage from septic tanks or cesspools, chemical contamination, and surface runoff contamination. An increase in the number of outbreaks resulting from the use of untreated, contaminated well water was noted during the summer months. (Author's abstract)
W86-04610

EFFECTS OF CD(II) AND CU(II) ON A BIOFILM SYSTEM,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-04643

RESPONSE OF PHOTOSYNTHETIC PARAMETERS TO ENVIRONMENTAL FACTORS IN SIGGEFORASJON, SWEDEN,
Uppsala Univ. (Sweden). Limnologiska Institutionen.
U. Heyman.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 155-175, April 1986. 8 fig, 9 tab, 35 ref.

Descriptors: *Photosynthesis, *Environmental effects, Lake Siggeforasjon, *Sweden, Assimilative capacity, Biomass, Chlorophyll, Chemical analysis, Phytoplankton, Light intensity, Regression analysis, Statistical analysis.

Primary productivity, phytoplankton biomass and species composition, zooplankton biomass, chlorophyll and environmental parameters were measured from composite samples on 44 occasions during 1977 and spring 1978. The parameters of the equation, assimilation maximum (A sub m) and photosynthetic efficiency (alpha), were divided by phytoplankton biomass, chlorophyll or expressed per unit water volume. These values as well as chlorophyll concentration and chlorophyll per biomass were related to water chemistry, light and plankton biomass and composition by means of multiple regression. The chlorophyll content per unit biomass varied in a fairly predictable way to temperature, and the average light intensity over the two days that preceded sampling. A sub m was dependent on temperature, biomass and species composition but not on chlorophyll. A sub m per unit biomass could be shown to covary with the phosphorus content per unit biomass, and up to 80% of the variation could be explained by the

regressions. The division of A sub m by chlorophyll only increased the unexplained variation, indicating that the algae adapted their chlorophyll content to the rate of dark reactions, which was also indicated by the variation in chlorophyll per biomass. The use of assimilation number (A sub m/chlorophyll) as an indicator of adaptation and general status of the phytoplankton was thus of no value in this study. Alpha was relatively independent of chlorophyll and was mainly determined by light intensity, the rate of dark reactions (A sub m) and species composition. I sub k (A sub m/alpha) covaried with the average light intensity but regression equations could only explain half of the variance. The regression equations explained large parts of the variation and rather good agreement between measured and predicted integrated assimilation was found. (Lantz-PTT)
W86-04647

EFFECTS OF FOREST FIRE AND OTHER DISTURBANCES ON WILDERNESS LAKES IN NORTHERN MINNESOTA: 1. LIMNOLOGY,
National Oceanic and Atmospheric Administration, Ann Arbor, MI. Great Lakes Environmental Research Lab.
For primary bibliographic entry see Field 4C.
W86-04648

MACROPHYTE DECOMPOSITION IN TWO TROPICAL LAKES,
Fisheries Research Inst., Szarvas (Hungary).
S. Ayyappan, J. Olah, S. L. Raghavan, V. R. P. Sinha, and C. S. Purushothaman.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 219-231, April 1986. 3 fig, 5 tab, 27 ref.

Descriptors: *Macrophytes, *Decomposition, *Lakes, *Tropical regions, Cellulose, Protein, Water hyacinth, Decomposing organic matter, Temperature effects, Cycling nutrient, India.

Seasonal and vertical variations in the decomposition rates of an aquatic macrophyte and two other substrates (filter paper cellulose and silk protein) provided as its ingredients in two representative freshwater lakes of India, are discussed. An in situ procedure to measure the weight losses was developed that provides a simple means of obtaining quick estimates. Of the three substrates, water hyacinth showed maximum decomposition rates ranging from 40 to 11 daily percent of weight loss in the pond and from 1.1-6.3 in the lake. The values for cellulose ranged from 0 to 3.6 in the pond and from 0.1 to 3.5 in the lake. Weight loss of protein was smaller, ranging from 0 to 3 in the pond and from 0 to 1.2 in the lake. Seasonal maxima developed during temperature maxima for hyacinth, and during minima for model substrates with some deviations. Weight losses were higher in bottom water and at the sediment-water interface. Decomposition was compared and discussed with the measured physico-chemical environment and bacterial communities in the two water bodies as well as with weight loss magnitude known for other water bodies. Decomposition under these tropical conditions was much higher than in the temperate zone, with rapid decomposition an important function in mineral recycling in nutrient deficient tropical waters. (Lantz-PTT)
W86-04649

STUDIES ON THE ACUTE TOXICITY OF POLLUTANTS TO FRESHWATER MACROINVERTEBRATES: 4. LINDANE (GAMMA-HEXACHLOROCYCLOHEXANE),
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
D. W. J. Green, K. A. Williams, and D. Pascoe.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 263-273, April 1986. 1 fig, 2 tab, 33 ref.

Descriptors: *Lindane, *Macroinvertebrates, *Pesticide toxicity, Gamma-Hexachlorocyclohexane, Trichopterans, Platyhelminths, Mollusks, Crustaceans, Plecopterans, Ephemeropterans, Dipterans, Oligochaetes, Lethal limit, Water pollution effects, England.

The acute toxicity of lindane to ten species of macroinvertebrates was examined. Species tested included a trichopteran, platyhelminth, and mollusk, to represent taxa for which there is no available literature on lindane toxicity. Plecopteran, ephemeropteran, dipteran, crustacean, and oligochaete species, (for which there is some information, at least on taxonimically related species) were also tested. Considerable interspecific differences in sensitivity were observed. The most sensitive species tested was Baetis rhodani (96 hr LC50 54 microgram lindane/l, where LC50 is the media lethal concentration), and the most tolerant species were Polycelis tenuis and Physa fontinalis which showed no mortality in up to 21 days when exposed to 430 microgram lindane/l. The relative sensitivity of species determined in this study is not radically different from that which emerges from an inspection of the literature, but is appears that species used in this study exhibit higher 48 hr and 96 hr LC50's than related species tested in other investigations. Possible reasons for these differences are discussed. Concentrations of lindane in United Kingdom freshwaters, generally lower than 1 micrograms lindane/l, are unlikely to bring about short term mortality in the species tested in this study. However, the possible release of lindane in high concentrations, and in combination with other pesticides, suggests that further investigations of its toxicity, both individually and in mixtures, should be carried out in order to determine the amounts required to kill macroinvertebrates after brief exposure to high concentrations. (Lantz-PTT)
W86-04651

STUDIES ON THE ACUTE AND CHRONIC EFFECT OF A 2,4-D-CONTAINING HERBICIDE (DIKONIRT) ON EUDIAPTOMUS GRACILIS (G. O. SARS) (CRUSTACEA, COPEPODA),
Balatoni Limnologiai Kutato Intezete, Tihany (Hungary).
M. Presing, and J. E. Ponyi.
Archiv fur Hydrobiologie AHYBAY, Vol. 106, No. 2, p 275-286, April 1986. 4 fig, 2 tab, 24 ref.

Descriptors: *Toxicity, *Lethal limit, *Herbicides, *Eudiaptomus gracilis, Crustaceans, Dikonirt, Lake Balaton, Hungary, Dichlorophenol, Sodium, Physiological ecology, Water pollution effects.

The spring generation of Eudiaptomus gracilis proved to be more susceptible 2,4-D-containing herbicide (Dikonirt) in Lake Balaton, than those generations present during other seasons. Mean lethal concentration (LC50) values for the examination periods in winter, spring, summer and autumn were the following: 90.9, 68.6, 75.2, 81.9 mg/l, respectively. Examinations of the spring generation showed the effective agent (2,4-D) of the herbicide and its Na-salt to be less toxic on E. gracilis (LC50 = 144.1 and 173.4 mg/l, respectively) than the commercial product (LC50 = 68.6 mg/l). The contaminant dichlorophenol with LC50 96 hr of 6.3 mg/l proved to be the most toxic. The toxicity of Dikonirt, containing about 2% dichlorophenol and 71.1% 2,4-D, was due to the synergistic effect of the two compounds. At a concentration ten times lower than LC50 (i.e. at concentrations lower than the so called harmless one) Dikonirt diminished the number of eggs of the animals of the autumn and summer generations. During the 3-week studies, the females two times carried sacs of the experimental animals, which were observed. In the autumn experiments, the average number of eggs of animals living in a 2.5 mg/l Dikonirt concentration was significantly smaller than in the control. During the summer investigations, at 2.5 mg/l concentration, the average number of eggs was significantly smaller during both clutches, than in the case of animals living in the control Balaton Lake water. (Lantz-PTT)
W86-04652

EFFECT OF THREE DRILLING FLUIDS ON GROUND WATER SAMPLE CHEMISTRY,
Geological Survey, San Antonio, TX. Water Resources Div.
R. B. Brobst, and P. M. Buszka.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 62-70, Winter 1986. 7 fig, 2 tab, 16 ref.

Descriptors: *Groundwater pollution, *Drilling fluids, *Chemical analysis, Guar bean, Bentonite, Sulfates, Monitoring wells, Antigo, Wisconsin.

Three monitoring wells were installed in borings that were constructed using water-based drilling fluids containing either (1) guar bean, (2) guar bean with breakdown additive, or (3) bentonite. These fluids were selected to observe their effect on the chemistry of subsequent water samples collected from the wells. The wells were installed to depths of 66 feet, 100.5 feet and 103 feet, respectively, in fine-to-medium sand and gravel outwash deposits near Antigo, Wisconsin. The bentonite and guar drilling fluids caused temporarily elevated concentrations of chemical oxygen demand (COD) in groundwater samples collected from the monitoring wells. Using standard development, purging and sampling procedures, elevated COD concentrations persisted for about 50 days for the well bored with the guar-with-additive fluid, 140 days for the bentonite well and 320 days for the guar well. Unfiltered groundwater samples for all wells had greater concentrations of COD than samples filtered through a 0.45 micron filter. Sulfate concentrations also decreased with time in the guar-with-additive well and bentonite well, but not in the guar well. The elevated COD concentrations are attributed to large concentrations of oxidizable carbon present in the guar bean drilling fluid and in the organic polymers present in the bentonite drilling fluid. Future research should evaluate the physical and geochemical interaction of different drilling fluid compositions with a variety of geologic matrices and drilling, well development and well purging techniques. (Lantz-PTT)
W86-04655

EFFECTS OF O3 AND ACIDIC RAIN ON PHOTOSYNTHESIS AND GROWTH IN SUGAR MAPLE AND NORTHERN RED OAK SEEDLINGS,
Boyce Thompson Inst. for Plant Research, Ithaca, NY.
P. B. Reich, A. W. Schoettle, and R. G. Amundson.
Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 1, p 1-5, January 1986. 2 fig, 4 tab, 24 ref.

Descriptors: *Ozone, *Acid rain, *Photosynthesis, *Plant growth, Environmental effects, Simulated rainfall, Chlorophyll, Maple trees, Red oak trees, Air pollution.

Two-year-old sugar maple Acer saccharum and northern red oak Quercus rubra seedlings were exposed to all combinations of several levels each of ozone (O3) and simulated acidic rain. Deposition rates and amounts of simulated rain were normal for eastern North America (12.5 mm of rain twice/wk) and levels of acidity in the various treatments ranged between pH 5.6 and 3.0. Plants were exposed to O3 for 7 hr/day, 5 d/wk. Concentrations of O3 were constant and ranged between 0.02 and 0.12 microliters/l in the various treatments. Ozone treatments caused significant declines in net photosynthesis in both species, with the largest reductions observed (30% in maple and 20% in oak) after two months in the highest O3 treatment (0.12 microliters/l). Reductions in growth as a result of O3 treatments occurred in sugar maple, but apparently due to the relatively short duration of the pollution treatments, growth reductions were not observed in red oak. Chlorophyll contents in sugar maple leaves increased as a result of O3 exposure. Simulated acidic rain treatments had no effect on either net photosynthesis or growth in either species and no interactive effects of the two pollutants were observed. (Lantz-PTT)
W86-04660

EXAMINATION OF ENVIRONMENTALLY SAFE LEVELS OF ZINC (II), CADMIUM (II) AND LEAD (II) WITH REFERENCE TO IMPACT ON CHANNELFISH NURIA DENRICUS,
Centre for Water Resources Development and Management, Kunnamangalam (India).
S. A. Abbasi, and R. Soni.

Environmental Pollution (Series A) EPEBD7, Vol. 40, No. 1, p 37-51, January 1986. 4 fig, 4 tab, 45 ref.

Descriptors: *Environmental effects, *Lead, *Zinc, *Cadmium, *Channelfish, Heavy metals, Toxicity, Survival, Water quality standards.

As a continuation of earlier studies on the impact of heavy metals on aquatic organisms, the behavioral responses and survival of the teleost Nuria denricus exposed to different levels of zinc (II), cadmium (II) and lead (II) were studied. Safe concentration (SC) values of the metals were determined with the help of computer-aided long-term bioassays. Comparisons of the SC with the minimum allowable levels of the corresponding metals in drinking water, effluents, irrigation water and fisheries revealed that, except for a few cases, the existing national and international water quality standards for various water uses are higher than the SC. A significant decrease in survival was observed in all zinc concentrations except 1.0 and 5.0 mg/l. With cadmium a significant decrease in survival was noted in concentrations above. 0.05 mg/l with 100% mortality observed within 50, 720 and 1100 hr in the 10, 5 and 1 mg/l exposures, respectively. In lead exposures, the mortality of the animals was significantly higher (43-100%) in concentrations above 0.5 mg/l. At lower concentrations, 0.05 and 0.5 mg/l, the mortality after 1100 hr was 30% and 17%, respectively. The disparity between the SC and the permitted levels of zinc and cadmium was especially noteworthy, indicating the need for a thorough re-evaluation of the toxicity and safe levels of these metals. (Lantz-PTT)
W86-04661

REVIEW OF TOXICITY TESTING AND DEGRADATION STUDIES USED TO PREDICT THE EFFECTS OF DIFLUBENZURON (DIMILIN) ON ESTUARINE CRUSTACEANS,

Research Triangle Inst., Research Triangle Park, NC. Center for Environmental Systems.
P. A. Cunningham.
Environmental Pollution EPEBD7, (Series A), Vol. 40, No. 1, p 63-86, January 1986. 1 fig, 4 tab, 44 ref.

Descriptors: *Toxicity, *Diflubenzuron, *Crustaceans, *Estuaries, Chemical degradation, Dimilin, Insect control, Saline water, Fresh water, Biological analysis, Environmental effects, Mosquitoes, Hydrogen ion concentration, Temperature effects.

This review surveys the pertinent literature on the effects of diflubenzuron (DFB)(Dimilin) on nontarget crustacean species when applied for mosquito control to freshwater and saltwater habitats. Freshwater research has focused on field testing, while estuarine research has been limited almost exclusively to laboratory toxicity studies. Several experimental design factors may affect the toxicity and persistence of diflubenzuron. These factors include formulation, frequency of application (exposure), presence of organic matter and sediment in the test system, pH, and water temperature. Biological factors such as the age of the test organism and the frequency and synchrony of moulting during the exposure period also influenced the observed response of the experimental crustacean population. Assessment of the impact of DFB on estuarine crustaceans is difficult as few studies have been conducted under conditions appropriate to its use in saltmarsh mosquito control. (Author's abstract)
W86-04662

GAS METABOLISM EVIDENCE IN SUPPORT OF THE JUXTAPOSITION OF HYDROGEN-PRODUCING AND METHANOGENIC BACTERIA IN SEWAGE SLUDGE AND LAKE SEDIMENTS,

Max-Planck-Inst. fuer Chemie, Mainz (Germany, F.R.).
R. Conrad, T. J. Phelps, and J. G. Zeikus.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 3, p 595-601, September 1985. 6 fig, 1 tab, 35 ref. DOE Grant AC02-80ER1075.

Descriptors: *Gas metabolism, *Methane bacteria, *Hydrogen bacteria, *Septic sludge, *Lake sediments, Kinetics, Anaerobic digestion, Lake Mendota, Wisconsin.

Developed are new techniques to measure dissolved H2 and H2 consumption kinetics in anoxic ecosystems that were not dependent on headspace measurements or gas transfer-limited experimentation. These H2 metabolism parameters were then compared with measured methane production rates, and estimates of H2 production and interspecies H2 transfer were made. The H2 pool sizes were 205 and 31 nM in sewage sludge from an anaerobic digestor and in sediments (24 m) from Lake Mendota, respectively. The H2 turnover rate constants, as determined by using in situ pool sizes and temperatures, were 103 and 31/h for sludge and sediment, respectively. The observed H2 turnover rate accounted for only 5 to 6% of the expected H2CO2 dependent methanogenesis in these ecosystems. Results are in general agreement with the results reported previously and are used to support the conclusion that most of the H2-dependent methanogenesis in these ecosystems occurs as a consequence of direct interspecies H2 transfer between juxtapositioned microbial associations within flocs or consortia. (Lantz-PTT)
W86-04665

MODELING THE RESPONSE OF GREENHOUSE-GROWN RADISH PLANTS TO ACIDIC RAIN,

Argonne National Lab., IL. Environmental Research Div.
P. M. Irving.
Environmental and Experimental Botany EEBODM, Vol. 25, No. 4, p 327-338, November 1985. 6 fig, 9 tab, 12 ref. EPA Agreement No. DW930126-01-0 and EPRI Contract No. RP 1908-1.

Descriptors: *Acid rain, *Radishes, *Model studies, Simulated rainfall, Greenhouses, Hydrogen ion concentration, Crop yield, Crop production, Photosynthesis, Environmental effects.

Many dose response studies have occurred in recent years, emphasising the need to assess and determine the impacts of acid rain. Experimental design parameters and model evaluation play important roles in the overall conclusions of such studies. To illustrate the importance of some of these factors, three dose-response studies on radish (Raphanus sativas L.) plants exposed to simulated rain were performed in a greenhouse. Significant negative effects on marketable yield occurred from simulated rain having pH levels below 3.8 in one experiment and below 3.4 in another. The apparent threshold level may have been dependent on environmental conditions which affected overall growth rates. In modeling the experimental results, treatments have very high levels of acidity had an overwhelming influence on the dose-response function used to describe the results. Plants treated with the highest acidity levels had reduced leaf area which resulted in lower photosynthesis per plant and may have been responsible for the reduced yields of plants. In addition to acidity, the sulfate to nitrate ratio in simulated rain also influenced radish response. Nitric acid appeared to have a greater effect than sulfuric acid in reducing yield at pH 3.0. (Lantz-PTT)
W86-04668

RESPONSES OF THREE WHEAT CULTIVARS TO SIMULATED ACID RAIN,

Oak Ridge National Lab., TN. Environmental Sciences Div.
J. W. Johnston, and D. S. Shriner.
Environmental and Experimental Botany EEBODM, Vol. 25, No. 4, p 349-353, November 1985. 2 fig, 3 tab, 15 ref. DOE No. 40-740-78, EPA No. 79-N0533, and DOHER Contract No. DE-AC05-840R21400.

Descriptors: *Acid rain, *Wheat, *Simulated rainfall, Sulfuric acid, Nitric acid, Seedlings, Hydrogen ion concentration, Environmental effects, Grain crops, Crop production.

Seedlings of three wheat (Tritium aestivum L.) cultivars (Arthur 71, Abe, and Oasis) were exposed to simulated rain acidified to pH 5.6, 4.3, 4.0, 3.3, 3.0, or 2.3 with sulfuric and nitric acids. The parameters measured included foliage weight, tiller number, and the number of leaves with more than 10% necrosis per pot. The results showed that acid rain at average ambient levels (pH 4.3 or 4.0) caused reduced growth of Arthur 71 and Abe and had no effect on Oasis. At levels of acidity (pH 2.3) higher than those normally encountered in rain, all three cultivars exhibited enhanced growth. Tillering increased with rain acidity for Abe, but was relatively constant for both Arthur 71 and Oasis. The number of leaves with more than 10% tip necrosis increased with rain acidity for each cultivar. These results showed that differences in cultivar sensitivity may be important in efforts to assess the impact of acid rain on crop productivity. (Author's abstract)
W86-04669

MICROBIAL DECOMPOSITION OF CELLULOSE IN ACIDIFYING LAKES OF SOUTH-CENTRAL ONTARIO,

Toronto Univ. (Ontario). Dept. of Microbiology.
J. F. M. Hoeniger.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 315-322, August 1985. 6 fig, 2 tab, 52 ref.

Descriptors: *Microbial degradation, *Cellulose, *Acid rain, *Acidic water, *Ontario, Lakes, Bacterial analysis, Sediments, Water columns, Hydrogen ion concentration, Bacteria, Plankton, Ecological effects.

The rate of cellulose breakdown and density of bacterial populations were measured in the epilimnetic sediments and water columns of lakes in central Ontario that differ in pH, alkalinity, and nutrient status and are particularly sensitive to acidic inputs from atmospheric decomposition. There was no significant difference in decomposition rate in either oxic or anoxic sediment when mean epilimnetic pHs were in the range 5.5 to 6.9. The importance of these findings for the breakdown of autochthonous detritus in Canadian Shield lakes is discussed. Furthermore, the results of these experiments, in which dyed strips of cellophane (regenerated cellulose) were used as substrate, were compared with results of earlier decomposition studies carried out with coarse litter (leaves, twigs). Acridine orange direct counts of bacteria in the top 1 cm of sediment ranged from 5.5 times 10 to the 8th power to 1.0 times 10 to the 9th power/gm, and in planktonic water samples from 1,100,000 to 1,800,000/ml. Bacterial densities were significantly higher in both the shallow sediment ($P < 0.01$) and the water column ($P < 0.05$) of dystrophic lakes than at these sites in oligotrophic lakes. (Lantz-PTT)
W86-04672

INCIDENCE OF VIBRIO CHOLERAE AND RELATED VIBRIOS IN A COASTAL LAGOON AND SEAWATER INFLUENCED BY LAKE DISCHARGES ALONG AN ANNUAL CYCLE,

Valencia Univ. (Spain). Dept. of Microbiology.
E. Garay, A. Arnau, and C. Amaro.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 426-430, August 1985. 3 fig, 2 tab, 27 ref.

Descriptors: *Coastal lagoons, *Seawater, *Lake discharges, *Annual cycle, Vibrio cholerae, Albufera Lake, Valencia, Spain, Water temperature, Nutrients.

Most probable numbers of Vibrio cholerae and related vibrios were determined in Albufera Lake, Valencia, Spain, and in coastal waters under the influence of the lake discharges over the course of an annual cycle. The objective of this study was to evaluate the incidence of V. cholerae and related vibrios in a lake and in coastal waters south of Valencia influenced by the lake discharges over the course of a year. The effect of water temperature, type of water, and load of vibrios discharged by the lake into the sea was also evaluated. Maxi-

mum recovery of vibrios reached 1,000/ml in both types of waters analyzed. V. cholerae numbers reached 1,000 in one of the coastal sites. Frequently during the warm season, all vibrios isolated were identified as V. cholerae. Occasionally, no V. cholerae was recovered. The recovery of vibrios was significantly influenced by the temperature of the water and the type of water analyzed. Most of the V. cholerae isolates were included in Heiberg groups I and II, and nearly 50% of the strains used chitin as sole carbon source. Indole was not produced by 100% of the strains. All strains tested were non-O1 serovars. (Lantz-PTT)
W86-04674

SURVIVAL AND ENUMERATION OF THE FECAL INDICATORS BIFIDOBACTERIUM ADOLESCENTIS AND ESCHERICHIA COLI IN A TROPICAL RAIN FOREST WATERSHED,
Puerto Rico Univ., Rio Piedras. Dept. of Biology.
For primary bibliographic entry see Field 5B.
W86-04675

BACTERIAL BIOMASS, METABOLIC STATE, AND ACTIVITY IN STREAM SEDIMENTS: RELATION TO ENVIRONMENTAL VARIABLES AND MULTIPLE ASSAY COMPARISONS,
Academy of Natural Sciences of Philadelphia, Avondale, PA. Stroud Water Research Center.
For primary bibliographic entry see Field 5A.
W86-04677

5D. Waste Treatment Processes

ADIPIC ACID-ENHANCED LIME/LIMESTONE TEST RESULTS AT THE EPA ALKALI SCRUBBING TEST FACILITY,
Bechtel National, Inc., San Francisco, CA.
D. A. Burbank, and S. C. Wang.
Capsule Report EPA 625/2-82-029, April 1982. 21 p, 9 fig, 11 tab. Contract No. EPA 68-02-3114.

Descriptors: *Air pollution, *Fly ash, *Sulfur, Sulfur compounds, Adipic acid, Electric powerplants, Waste treatment, Industrial wastes, Economic aspects.

The results of testing adipic acid-enhanced lime and limestone for gas scrubbing at the Shawnee Power Station Test Facility are described. As background information, earlier adipic acid additive test results from a 0.1 MW pilot plant study are summarized. Also, the preliminary results from a 100 MW full-scale demonstration, and from a 27 MW equivalent industrial boiler test are reported. The results of the tests showed adipic acid to be very effective in improving SO2 removal efficiency, even when operating at chloride levels as high as 17,000 ppm. A TCA scrubber, which removed 82% of the inlet SO2 without the additive, yielded 89% SO2 removal with 700 ppm adipic acid, 91% removal with 1,000 ppm, and 93% with 2,000 ppm adipic acid. The limestone utilization was concurrently increased from 77% without the additive to 91% with 1,600 ppm adipic acid. The observed effects thus confirmed the theoretical expectations in all respects. In addition, the tests showed no serious interference by adipic acid on the performance of the oxidizer, operation at pH 6.1. The quality of the oxidized sludge was similar to that obtained when operating without adipic acid, although small differences were detected. (Halterman - PTT)
W86-03901

NEW AQUEOUS WASTE TREATMENT FACILITY AT ROCKY FLATS,
Atomics International Div., Golden, CO. Rocky Flats Plant.
K. G. Peter.
Report RFP--3259, 1982. 9 p, 1 ref.

Descriptors: *Wastewater treatment, *Radioactive wastes, *Water conservation, Water reuse, Cooling water, Evaporation, Clarification, Chemical precipitation, Boiler water, Sludge disposal, Flocculation, Rocky Flats.

The new waste treatment facility at Rocky Flats, Building 374, removes radioactive and chemical contaminants from aqueous process effluents collected from operations throughout the plant. Solids are separated from liquids in a three-stage precipitation process, each of which consists of a reactor, a flocculator, and a clarifier. Acidic wastes are made basic and filtered before being introduced into the first stage feed tank along with the basic wastes. Less hazardous wastes are introduced into the second or third stage. Sludge from the clarifiers is stored in a filter fed tank and fed into a rotary-drum vacuum filter. The filtrate is recycled to the first stage feed tank. The sludge is dried, cooled, and packaged for shipment offsite. The supernatant fluid from the three-stage precipitation process is filtered and fed into holding tanks, then into a multiple-effect evaporator. The water recovered from the evaporator is used as boiler feed water or cooling tower water. The concentrate is sent to a spray dryer and filter. The total average solids output is 400 kg/hr from an average feed rate of 14,900 liters/hr. Average dried sludge production is 80 kg/hr; average evaporator salt production is 320 kg/hr. (Cassar - PTT)
W86-03904

FINE PORE (FINE BUBBLE) AERATION SYSTEMS.
American Society of Civil Engineers, New York. Committee on Oxygen Transfer.
Summary Report EPA/625/8-85/010, October 1985. 50 p, 19 fig, 11 tab, 82 ref.

Descriptors: *Aerators, *Wastewater, *Waste, Wastewater treatment, Waste management, Waste treatment, Industrial wastewater, Municipal wastewater, Aeration.

Fine pore aeration is one of the most widespread methods used to treat wastewater. A description of currently used devices includes types of materials, types of fine pore diffusers, diffuser layout and characteristics of fine pore media. A summary of performance characteristics is presented for both clean water and process water performance. Operation and maintenance considerations include the impact of system design, installation, and fouling phenomena. A discussion of retrofit considerations includes design factors and economic analyses. (Halterman - PTT)
W86-03914

COMPOSTING OF MUNICIPAL WASTEWATER SLUDGES,
Eastern Research Group, Inc., Arlington, MA.
J. Connery.
Seminar Publication EPA 625/4-85-014, August 1985. 68 p, 82 fig, 23 tab, 21 ref.

Descriptors: *Sludge disposal, *Composting, Waste treatment, Waste management, Wastewater management, Wastewater treatment, Land application, Municipal wastewater.

General principles for the design of municipal wastewater sludge composting facilities are presented. Specific subjects covered include public relations aspects, aesthetic and environmental considerations, marketing and distribution, economic aspects, facility design considerations, site specifications, public health considerations, and process monitoring. Case histories, covering a variety of types and locations of composting facilities, are presented. Static pile composting operations, windrow facilities, and in-vessel composting are detailed in these case studies. Finally, federal and state regulations, pertaining to composting of municipal wastewater sludges, are reviewed. (Halterman - PTT)
W86-03917

MICROBIAL REMOVAL OF TRACE ORGANICS DURING RAPID INFILTRATION RECHARGES OF GROUND WATER,
Rice Center, Houston, TX.
S. R. Hutchins, and C. H. Ward.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 18-21, 2 fig, 3 tab, 25 ref.

Descriptors: *Organic compounds, *Trace levels, *Recharge, *Fate of pollutants, *Biodegradation, Rapid infiltration recharge, Groundwater, Soil, Induced infiltration, Water reuse, Artifical recharge.

Soil column tests and field experiments were designed to evaluate microbial removal of trace organics during rapid infiltration recharge of ground water. Column tests using acclimated soil from an operational system demonstrated good removal of trace organics. Increased concentrations of target compounds in the feed did not always results in corresponding increases in the column effluent. Microbial adaptation was evident for some compounds. Other compounds appeared to exhibit a minimum concentration below which biodegradation did not proceed. Microbial activity was confirmed as a fate mechanism for several target compounds using radiolabels. In direct correlation with field results, the induction of anaerobiosis in the soil columns resulted in increased fractional breakthrough of trace organics. (Author's abstract)
W86-04046

DENITRIFICATION DURING WASTEWATER RENOVATION GROUNDWATER RECHARGE,
Agricultural Research Service, Durant, OK. Water Quality and Watershed Research Lab.
J. C. Lance.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 22-24, 2 fig, 11 ref.

Descriptors: *Denitrification, *Groundwater recharge, *Wastewater renovation, Groundwater, Recharge, Experiments, Laboratory testing, Nitrates, Artificial recharge, Water reuse.

Ground water recharge is an effective way to renovate sewage water but recharge systems must be carefully designed and managed to avoid ground water contamination and to produce reclaimed water suitable for reuse. Nitrate can be removed from wastewater by alternating wetting and drying cycles in flooding basins to promote nitrification during the dry periods and denitrification during subsequent flooding periods. The proportion of nitrogen removed by denitrification depends upon the carbon content of the sewage water and the infiltration rate of the recharge basins. Ground water recharge is an effective way to renovate sewage water but recharge systems must be carefully designed and managed to avoid ground water contamination and to produce reclaimed water suitable for reuse. Field studies where groundwater recharge basins were intermittently flooded with secondary sewage effluent showed that systems with high infiltration rates (30 to 60 cm/day) removed most of the fecal microorganisms, organic material, and phosphates. Initial laboratory experiments showed that the NH4-N was adsorbed by the soil exchange complex during one flooding period and held until the dry period when oxygen entered the soil and nitrification occurred. The nitrate formed during the dry period was leached from the soil during the next flooding period, and the incoming sewage water provided organic carbon for some denitrification, while the NH4-N of the sewage water was adsorbed at the same time. The difficulty with this approach has been that nitrate which formed during the dry period is leached through the soil in a concentrated peak, and the concentration of organic carbon in the sewage water is too low for complete denitrification. Thirty percent of the nitrogen was removed when the loamy sand columns were flooded with secondary sewage effluent at infiltration rates of 30 to 40 cm/day, which agrees well with estimates of nitrogen removed by field recharge basins at comparable loading rates. (Lantz - PTT)
W86-04047

MICROBIAL ECOLOGY OF A HAZARDOUS WASTE DISPOSAL SITE: ENHANCEMENT OF BIODEGRADATION,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.

M. D. Lee, and C. H. Ward.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 25-27, 5 fig, 1 tab, 8 ref.

Descriptors: *Biodegradation, *Groundwater, *Waste disposal, Microbial activity, Aromatic compounds, Oxygen, Nutrients.

Pollution of ground water by organic compounds is a serious threat to the nation's water supply. Biodegradation of organic contaminants by the indigenous microbial population is one of the most effective methods for removing these contaminants. However, microbial activity in aquifers may be limited by the levels of dissolved oxygen, nutrients, or the numbers of microorganisms capable of degrading the contaminants. The effects of nutrient and oxygen addition on biodegradation were tested on ground water collected aseptically from a well at an abandoned wood-creosoting operation in Conroe, Texas. The ground water from this well is contaminated with 10-500 micrograms/liter levels of several polynuclear aromatic compounds including naphthalene, dibenzofuran, fluorene, 2-methyl naphthalene, and phenanthrene. To one sample, nutrients (nitrogen, phosphorus, potassium, carbonate, magnesium, calcium, manganese, sulfate, and iron) and dissolved oxygen were added. To another sample, dissolved oxygen alone was added to distinguish the effects of nutrient addition. One sample was incubated under nitrogen to simulate the oxygen limited conditions found in the aquifer. A sterile control was prepared by filter sterilization and the addition of 1% sodium azide. Results from the experiment indicate that the compounds were degraded most rapidly in the sample with nutrients and dissolved oxygen, but that the overall removal was as high in the sample supplied with dissolved oxygen. There was little or no removal in the control and no microbial growth. Microbial numbers increased most rapidly in the sample with added nutrients with a concurrent drop in the concentration of the contaminants. (Author's abstract)
W86-04048

BIODEGRADATION OF HALOAROMATIC SUBSTRATES IN A SHALLOW ANOXIC GROUND WATER AQUIFER,
Oklahoma Univ., Norman. Dept. of Botany and Microbiology.
J. M. Suflita, and S. A. Gibson.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 30-32, 3 fig, 2 tab, 17 ref. Contract No. CR811146-01-0.

Descriptors: *Biodegradation, *Groundwater reservoirs, *Groundwater pollution, *Water pollution treatment, *Haloaromatic substrates, Groundwater, Aquifers, Water pollution, Degradation, Path of pollutants, Fate of pollutants.

Anaerobic ground water aquifers receive a variety of xenobiotic contaminants, but the eventual fate of these chemicals is uncertain. We investigated whether several halogenated benzoates, phenols and phenoxy-acetic acid herbicides could be degraded in microcosms innoculated with anoxic aquifer material sampled from two sites near the municipal landfill in Norman, Oklahoma. One site was actively methanogenic, whereas carbon flow in the other site was apparently dominated by sulfate-reducing processes. After two months, benzoate and phenol were completely metabolized in samples from both sites, but phenoxyacetate persisted in sulfate-reducing microcosms. The methanogenic aquifer samples showed more than 80% conversion of 9 of 10 halobenzoates, 5 of 7 chlorophenols, and 2 of 2 phenoxyacetic acid herbicides. The sulfate-reducing aquifer samples showed no ability to transform the halogenated substrates during the initial period. High pressure liquid chromatography and mass spectral evidence indicated that the primary degradation pathway for these chemicals involved the loss of an aryl halide and its substitution by a hydrogen atom. Complete dehalogenation was required before the substrates could be completely mineralized. These results indicate that the microflora of anoxic aquifers have the potential to reductively metabolize xenobiotic chemicals under the proper environmental conditions. (Author's abstract)
W86-04050

MODELLING OF NITROGEN REMOVAL IN THE VADOSE ZONE,
Murdoch Univ. (Western Australia). School of Environmental and Life Science.
For primary bibliographic entry see Field 5B.
W86-04070

USE OF AN UPFLOW FIXED BED REACTOR FOR TREATMENT OF A PRIMARY SETTLED DOMESTIC SEWAGE,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
D. Amar, J. Partos, C. Granet, G. M. Faup, and J. M. Audic.
Water Research WATRAG, Vol. 20, No. 1, p 9-14, January 1986. 10 fig, 6 tab, 13 ref.

Descriptors: *Domestic wastes, *Aerobic treatment, *Fixed bed reactor, Wastewater treatment, Wastewater facilities, Design operations.

The study presents and demonstrates results obtained from an half full scale upflow fixed bed reactor (UFBR) treating a primary settled domestic sewage. This study used expanded clay with an effective size of 2.7 mm containing hematite and magnetite as a granular medium. The content of TSS in the effluent treated was always between 10 and 20 mg/l for bed depths ranging from 2 to 3 m and filtration rates of 3-6 cu m/m/hr. The profiles taken all along the reactor show that the activity of the biomass is constant over the whole height of the reactor. Moreover, an air/water volume ratio of 22:1 is amply sufficient to satisfy the oxygen demand of the biomass. The average removal efficiency based on the soluble COD remains virtually unchanged as a function of the filtration rate at about 70% of the influent. For a final BOD sub 5 of 30 mmg/l, loadings of 4.5-8 kg BOD sub 5/cum can be applied. This corresponds to filtration rates of 3-6 cu m/m/hr. The removal efficiencies for BOD sub 5 are then about 80%. After optimization of the backwashing conditions, the consumption of backwash water is about 5% of the volume of filtered water. Sludge measurements carried out during our experiments indicate an excess sludge production of 1 kg/kg BOD sub 5 eliminated. The nature of these sludges is very similar to the biological sludges produced in the high rate activated sludge process. This study has made it possible to establish design parameters of an UFBR and to develop technology for applications. These results are applied to two wastewater treatment plants which began to operate in 1984; these plants serve population equivalents of 40,000 and 11,000. (Author's abstract)
W86-04102

DEVELOPMENT OF A METHOD FOR THE RECOVERY OF ENTEROVIRUSES FROM AEROBICALLY DIGESTED WASTEWATER SLUDGES,
Florida Univ., Gainesville. Dept. of Environmental Engineering Sciences.
P. R. Scheuerman, S. R. Farrah, and G. Bitton.
Water Research WATRAG, Vol. 20, No. 1, p 15-19, January 1986. 4 tab, 23 ref.

Descriptors: *Enteroviruses, *Aerobic digestion, *Sludge digestion, Wastewater treatment, TCA-lysine procedure, Elution, Sodium trichloroacetate, Policvirus, Cost Analysis, Enterovirus recovery, Virus concentration.

A method was developed for virus recovery from aerobically digested sludge. This method, hereafter named the TCA-lysine procedure, consists of eluting virus from sludge with sodium trichloroacetate + lysine at pH 9.0. The eluates are further processed by two successive concentration steps. Comparison of this procedure was made to other methods. This procedure recovered 82% of added poliovirus from aerobic sludges. The range for the other procedures tested ranged from 1.1 to 66% recovery. Recovery of indigenous enteroviruses was found to be equal to or greater than other methods tested for both aerobically and anaerobically digested sludges. The TCA - lysine procedure is potentially more sensitive and cost effective than other methods tested due to the smaller concentration volume. In addition bacterial contamination of cell cultures used for viral assays was not as severe as with other procedures tested. (Author's abstract)
W86-04103

BATCH METAL REMOVAL BY PEAT - KINETICS AND THERMODYNAMICS,
Agence Financiere de Bassin Seine-Normandie, Paris (France).
T. Gosset, J.-L. Trancart, and D. R. Thevenot.
Water Research WATRAG, Vol. 20, No. 1, p 21-16, January 1986. 7 fig, 2 tab, 24 ref.

Descriptors: *Industrial wastewater, *Wastewater treatment, *Heavy metals, *Peat, Ion exchange, Cadmium, Copper, Nickel, Zinc, Kinetics, Thermodynamics.

Peat moss, a natural inexpensive material, is able to play an important role in treatment processes of metal-bearing industrial effluents since it adsorbs, complexes or exchanges various metal cations. This paper presents kinetics and thermodynamics of batch metal removal reactions by 50 g/l (dry wt) eutrophic or oligotrophic peat particles using Cu(+), Cd(-), Zn(+) and Ni(+) concentrations ranging from 0.01 to 100 mM. Metal cation removal reactions are moderately rapid in 10 millimole metal unbuffered solutions: the forward kinetic constant ranges between 00.005 and 0.17/M/s, and equilibrium is reached within about 1 hr. Under these conditions of pH (2.2-4.2) and concentrations, apparent binding equilibrium constants were found to range between 2 and 3150/M depending upon the peat origin and the metal cation. In 0-6.5 pH-buffered metal cation solutions, the four cations binding reactions behaved differently demonstrating that metal binding equilibrium constant decrease in the order Ni2+ > Cu2+ > Cd2+ > = Zn2+. When pH is higher than 6.7, more than 90% of a 10 mM metal cation solution is removed by 50 gl-1 peat particles and metal binding capacities equal 200 mmol kg-1 dry wt, whatever the metal nature and the peat origin. Except for nickel cation which is very strongly bound to peat, all metal cations are completely released when pH is fixed below 1.5. (Author's abstract)
W86-04104

BEHAVIOR OF CHLOROPHENOXY HERBICIDES DURING THE ACTIVATED SLUDGE TREATMENT OF MUNICIPAL WASTE WATER,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
N. P. Hill, A. E. McIntyre, R. Perry, and J. N. Lester.
Water Research WATRAG, Vol. 20, No. 1, p 45-52 January 1986. 4 figs, 3 tabs, 33 refs.

Descriptors: *Herbicides, *Activated sludge process, *Municipal wastewater, *Biodegradation, Chlorophenoxy herbicides, Adsorption, Sludge, Pilot plants, Organic compounds, Legislation.

The potential of the activated sludge treatment process for the removal of chlorophenoxy herbicides (CPH) from domestic waste water has been investigated. A series of laboratory jar tests and pilot plant experiments were performed using real settled sewage fortified with 10 microns/l of each of six CPH. The experiments were designed with the objective of assigning any CPH removal which might occur to a particular removal mechanism. In particular, the effect of varying the sludge age between each pilot plant experiment was studied, in view of the importance of sludge age in determining the biodegradative potential of activated sludge. Generally, activated sludge treatment proved ineffective in removing CPH contaminants from settled sewage. Statistical treatment of the data suggested that neither adsorption nor catabolic biodegradation were responsible for those signif-

icant CPH removals that did occur. Indeed, there was no evidence of acclimatization of the mixed liquor to the presence of CPH contaminants. Furthermore, there was no obvious effect of sludge age on the efficiency of CPH removal from settled sewage. However, the extent and pattern of substitution of CPH appeared to be important in determining the efficiency of CPH removal, which implies that a biological mechanism was involved. The likelihood that co-metabolism was responsible for CPH removal has been considered. The possible implications of poor CPH removal by activated sludge treatment have been discussed, with reference to the relevant EEC legislation. (Author's abstract)
W86-04107

MERCURY REMOVAL FROM PETROCHEMICAL WASTES,
Universita degli Studi 'La Sapienza', Rome (Italy). Dept. of Chemistry.
L. Campanella, E. Cardarelli, T. Ferri, and B. M. Petronio.
Water Research WATRAG, Vol. 20, No. 1, p 63-65, January 1986. 1 fig, 3 tab, 14 ref.

Descriptors: * Wastewater treatment, *Mercury, *Petrochemical wastes, Oil wastes, Industrial wastes, Flocculation, Sedimentation, Starch xanthate.

The precipitation of mercury as mercury-starch-xanthate is studied. The process is studied in terms of optimum mercury-xanthate molar ratio, of influence of flocculation sedimentation times, and of interferences (aluminum, iron, silica, chloride, organic substances and suspended solids). The studied reaction is advantageously applied to mercury removal from petrochemical wastes. The use of starch xanthate gives very interesting results both for the high mercury removal (>99%) obtained, and for the very low cost of this natural compound. Because the formation rate of mercury-starch xanthate product is higher than the degradation one, it seems that starch-xanthate is stabilized by mercury. The optimized process is applied both to a simulated and to a real wastewater, coming from a petrochemical industry. (Lantz-PTT)
W86-04109

DEGRADATION OF MCPA BY OZONE AND LIGHT,
California Univ., Davis. Dept. of Environmental Toxicology.
J. L. Benoit-Guyod, D. G. Crosby, and J. B. Bowers.
Water Research WATRAG, Vol. 20, No. 1, p 67-72, January 1986. 3 fig, 3 tab, 36 refs.

Descriptors: *Degradation, *Ozonation, *Light, Ultraviolet Radiation, 4-chloro-2-methyl-phenoxyacetic acid, Degradation products, Ozone, Herbicides, Aromatic compounds, Hydrocarbons.

The degradation of dilute aqueous solutions of the herbicides, MCPA (4-chloro-2-methyl-phenoxyacetic acid), by ozone has been examined in the presence and absence of very low energy ultraviolet light (>300nanometers) to identify early benzenoid intermediates. In the dark, ozonolysis proceeded rapidly, and a series of benzenoid intermediates could be isolated, including 4-chloro-2-methyl-phenol, its formate ester, 5-chlorosalicylaldehyde and 5-chlorosalicyclic acid. Isolation of 5-chloro-3-methylbenzene-1,2-diol from dark ozonolysis suggests the operation of two distinct ozonolysis pathways: ring-hydroxylation and cleavage by molecular ozone in the dark, and side-chain oxidation by hydroxyl radicals under irradiation. (Author's abstract)
W86-04110

EFFECT OF OPERATION CONDITIONS ON BIOLOGICAL FE(2+) OXIDATION WITH ROTATING BIOLOGICAL CONTACTORS,
Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-04111

CONCENTRATION OF ROTAVIRUS BY ULTRAFILTRATION,
Queen Elizabeth II Medical Center, Nedlands (Australia). Combined Clinical Microbiology Service.
For primary bibliographic entry see Field 5G.
W86-04112

ANAEROBIC PURIFICATION OF WASTE WATER FROM A POTATO-STARCH PRODUCING FACTORY,
Groningen Rijksuniversiteit (Netherlands). Dept. of Microbiology.
H. J. Nanninga, and J. C. Gottschal.
Water Research WATRAG, Vol. 20, No. 1, p 97-103, January 1986. 1 fig, 5 tab, 53 ref.

Descriptors: *Anaerobic digestion, *Food-processing Wastes, *Industrial wastewater, *Potato starch factory, DeKrim, Netherlands, Sedimentation basins, UASB methane reactor, Sludge, Upflow reactor, Fermentation, Sulfate reduction.

The waste water of the potato-starch factory of the AVEBE in DeKrim (The Netherlands) passed through, during the anaerobic purification, a sedimentation pond, a first upflow reactor (in which there was practically no sludge retention) and a UASB methane reactor. The fermentation of free-amino acids and smaller peptides occurred in the sedimentation pond and first reactor. Proteins and longer peptides were degraded in the first reactor and in the methane reactor. The decrease in COD and TOC content of the waste water between influent sedimentation pond and effluent methane reactor was 83 and 71%, respectively. In the effluent of the first reactor, 60% of the inorganic sulfur was present as sulfide. (Author's abstract)
W86-04115

BATCH COAGULATION OF A LAGOON FOR FECAL COLIFORM REDUCTIONS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
G. R. Finch, and D. W. Smith.
Water Research WATRAG, Vol. 20, No. 1, p 105-112, January 1986. 3 fig, 9 tab, 28 ref.

Descriptors: *Batch treatment, *Coagulation, *Wastewater lagoons, *Coliforms, Aluminum sulfate, Hydrogen ion concentration, Alum, Wastewater treatment, Phosphorus, Suspended solids, Biochemical oxygen demand.

Research on the factors affecting fecal coliform removal from lagoon wastewater by batch treatment with aluminum sulphate was based on factorial designs and jar tests to determine the statistically significant factors controlling the removal of fecal coliform bacteria. Temperature, chemical dose, pH, rapid mixing and flocculation were examined at two different laboratory scales. The results indicated that alum dose and pH were the only significant parameters. A design chart was developed for the wastewater tested enabling dose determination for a desired fecal coliform reduction. This chart was used to select the dose for a full scale field trial to reduce fecal coliforms to <10/100 ml. The design dose was 300 ml/l Al2(SO4)3 18H2O and a final pH of 6.4 was predicted. The field trial used liquid alum (Al2(SO4)3 14.2 H2O) delivered by tanker truck and distributed by motor boat. The treatment reduced fecal coliforms by 99.9%, total phosphorus by 97%, total suspended solids (TSS) by 90% and 5-day carbonaceous biochemical oxygen demand (CBOD5) by 35%. (Author's abstract)
W86-04116

ANAEROBIC TREATMENT OF PHENOLIC COAL CONVERSION WASTEWATER IN SEMICONTINUOUS CULTURES,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
P. M. Fedorak, and S. E. Hrudey.
Water Research WATRAG, Vol. 20, No. 1, p 113-122, January 1986. 8 fig, 8 tab, 25 ref.

Descriptors: *Anaerobic digestion, *Phenols, *Coal conversion, *Wastewater treatment, *Cultures, Industrial wastewater, Methane, Coal gasification, p-cresol, m-cresol.

High strength wastewater (7600 mg/l phenolics) from the H-coal liquefaction process was diluted and fed to anaerobic, methane-producing cultures. Total phenolic concentrations of 150 and 300 mg/l were added to 50 ml semicontinuous cultures with hydraulic retention times of 12.5, 16.7 and 25 days. The rates of methane production and effluent concentrations of three fermentable phenolics (phenols, p-cresol and m-cresol) were monitored over 188-day period. After acclimation to the wastewater, stable periods followed during which each of the six cultures removed essentially all of these fermentable phenolics. The duration of the stable periods decreased with increasing phenolic mass loading rates. m-Cresol was the first phenolic to appear in the effluent and its presence served as the first indicator of reduced phenolic removal capability. The effluent m-cresol concentrations from cultures receiving 300 mg/l total phenolics followed simple washout curves suggesting that its degradation stopped abruptly. Later, p-cresol and ultimately phenol appeared in the effluents from the cultures which received the highest phenolic mass loadings. (Author's abstract)
W86-04117

GRAPHICAL REPRESENTATION OF A NEW LINEAR FORM OF THE LANGMUIR ADSORPTION ISOTHERM (REPRESENTATION GRAPHIQUE D'UNE NOUVELLE FORME LINEARISEE DE L'EQUATION DE l'ISOTHERME DE LANGMUIR),
Limoges Univ. (France). Lab. de Genie Chimique, Traitement des Eaux.
P. Lafrance, M. Mazet, D. Villessot, and J.-C. Thomas.
Water Research WATRAG, Vol. 20, No. 1, p 123-129, January 1986. 3 fig, 5 ref.

Descriptors: *Mathematical equations, *Graphical analysis, *Langmuir isotherm, *Isotherms, Adsorption, Drinking water, Industrial wastewater, Water pollution treatment, Langmuir equation, Graphical methods.

A graphical representation of a new linear form of the Langmuir equation, for single-solute adsorption, is presented. Since there is a mathematical similarity between the Langmuir equation and the Michaelis-Menten equation used to describe enzyme kinetics, it is proposed that a recent description of a particular method of plotting enzyme kinetic results may be extended to adsorption equilibrium studies. For a single-solute adsorption equilibrium, the Langmuir equation can be rearranged to show the dependance of gamma(omega) on K(-1), giving the relation: gamma(omega)=gamma+gamma/c(K(-1)). Previous experimental results concerning the static adsorption, on powdered activated carbon, of micromolar quantities of 2-naphtol alone and in presence of increasing concentration of sodium dodecyl sulphate (SDS), are presented by the method of 'direct linear plots'. It can be seen from this representation that: (1) In a real experiment computing many values of gamma, the point of intersection of corresponding straight lines gives, a satisfactory evaluation of the absolute value of gamma(omega) and absolute value of K(-1), in comparison with results obtained from the classical Langmuir isotherm; (2) for a particular adsorption isotherm, the scattering of the intersection point provides a clear representation of experimental errors and/or the validity of the linear form of the Langmuir equation to describe experimental data; (3) a qualitative and quantitative picture of the variation of equilibrium parameters for 2-naphtol in the presence of an increasing concentration of SDS, shows the effect of a multi-component system on the adsorptive capacity and affinity of the carbon for a particular solute; and (4) if the linearity of the classical Langmuir isotherm is assumed, direct linear plots can focus attention directly on values of equilibrium parameters as a function of system characteristics. (Lantz-PTT)
W86-04118

ACTIVATED SLUDGE RESPIROMETRIC MEASUREMENTS,
United Nations Development Programme.
J. Suschka, and E. Ferreira.
Water Research WATRAG, Vol. 20, No. 2, p 137-144, February 1986. 11 fig, 2 tab, 10 ref.

Descriptors: *Activated sludge, *Respirometry, *Biological oxygen demand, *Oxygen probe, Oxygen demand, Oxygen uptake, Respiration, Kinetics, Substrate removal.

Respirometric measurements of activated sludge were shown to be a valuable source of information with respect to the kinetics of substrate biooxidation. Two new techniques were elaborated which used an oxygen probe to enable determination of different rates of oxygen consumption. It would appear possible to determine the biochemical oxygen demand of a given substrate based on short period oxygen consumption measurements. The two techniques applied have shown consistency, both in evaluation of oxygen consumption rates as an operational parameter at an activated sludge treatment plant and in determination of substrate biochemical oxygen demand rate. The respirometric measurement, as shown can also be used to evaluate the biomass yield coefficient. (Author's abstract)
W86-04120

NITROGEN REMOVAL IN A SEMI-CONTINUOUS PROCESS,
Technion - Israel Inst. of Tech., Haifa. Faculty of Civil Engineering.
Y. Argaman.
Water Research WATRAG, Vol. 20, No. 2, p 173-183, February 1986. 7 fig, 2 tab, 9 ref, append.

Descriptors: *Denitrification, *Wastewater treatment, *Semi-continuous process, *Activated sludge, Nitrification, Retention Time.

Laboratory tests using synthetic feed were conducted to evaluate the nitrogen removal capabilities of the continuously fed intermittently decanted (CFID) process. Experimental results were in general agreement with theoretically predicted values. Ammonia removal is governed by the extent of nitrification during aeration, and the level of leakage during settling and decantation. The former is controlled by the aerobic SRT, with the critical value being approximately 5 days at 13-18 C. Ammonia leakage is controlled by hydraulic parameters. For a given nominal hydraulic residence time, short cycle, short settling and short decantation times are conducive to low leakage. Total removal of nitrogen can be obtained if a well nitrifying system is allowed to denitrify. Denitrification is affected primarily by the anoxic fraction of the cycle. The specific denitrification rate ranged from 0.014 to 0.037 g N S/S day, which is comparable to reported values for internal or endogenous denitrification in conventional systems. (Author's abstract)
W86-04124

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - I: OZONE CONSUMPTION AND OZONATION PRODUCTS,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, S. Guyon, H. Sugimitsu, and M. Dore.
Water Research WATRAG, Vol. 20, No. 2, p 197-208, February 1986. 11 fig, 6 tab, 20 ref.

Descriptors: *Ozonation, *Naphthalene, *Ozone, Surface water, Aromatic compounds, High performance liquid chromatography, Gas chromatography, Mass spectroscopy, Chemical analysis.

Ozonation of a polyaromatic compound, naphthalene, was studied in a dilute aqueous medium, in order to determine the consumption of ozone and to quantify by High Performance Liquid Chromatography (HPLC) the ozonation by-products. An identification of by-products by Gas Chromatography/Mass Spectrometry GC/MS techniques was undertaken from a concentrated solution of naphthalene in a H2O/Ch3OH mixture. Ozonation of aqueous solution of naphthalene (0.00025 mol/l, pH = 5.9) was carried out in a continuous semi-batch reactor. The HPLC analysis of naphthalene and of ozonation by-products and the determination of ozone consumed showed that, when naphthalene has completely disappeared. The analyzed products represent only 30% of the initially introduced organic carbon. Later separation and identification of ozonation by-products from a more highly concentrated solution of naphthalened in a mixture H2O/CH3OH (50/50v/v) allowed the identification of: oxalic acid, oxomalonic acid, a cyclic peroxide, phthalic acid and phthalaldehydic acid. Taking into account the consumption of 2 mol of ozone per mol of compound removed, the identified oxidation products and the data found in the literature, three reactional pathways are proposed for the initial attack of ozone on naphthalene: 1) an electrophilic substitution of ozone on carbon 1 (or 2) of the naphthalene, 2) two simultaneous 1,3-dipolar cycloaddition of ozone on 1,2 bond of naphthalene. (See also W86-04127) (Author's abstract)
W86-04126

OZONATION OF NAPHTHALENE IN AQUEOUS SOLUTION - II: KINETIC STUDIES OF THE INITIAL REACTION STEP,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
B. Legube, H. Sugimitsu, S. Guyon, and M. Dore.
Water Research WATRAG, Vol. 20, No. 2, p 209-214, February 1986. 5 fig, 3 tab, 6 ref.

Descriptors: *Ozonation, *Naphthalene, *Kinetics, Activation energy, Chemical analysis, Batch reactors, Aromatic compounds, Hydrogen Ion Concentration.

The kinetic study of naphthalene (N) ozonation in aqueous solution was carried out in order to specify the pathway of the initial ozonation step of this compound. The study was carried out mainly at pH 5.6 at 1 C in a batch reactor. The initial concentrations of reactants were chosen so that the opening of a second aromatic ring of naphthalene would not be significant, and were: 1) (naphthalene)sub 0 = 0.000004-0.000007 mol/l, and (ozone)sub 0 = 0.000006-0.00001 mol//l. All the results obtained at pH 5.6, by analysis of ozone and naphthalene consumed showed that: 1) the stoichiometry of the initial reaction step was 2 mol of ozone by mol of naphthalene, 2) a two-order kinetic law was verified for a large period of time and with different initial concentrations (linear correlation about 0.99), and 3) the average of rate constant values (1 C, pH 5.6) was 550 + or - 80 l/mmol/s. These data exclude, on the one hand, the hypothesis of an electrophilic substitution, which requires a stoichiometry at least equal to three, and on the other the hypothesis of two simultaneous 1,3-dipolar cycloaddition which implies a three-order kinetic reaction. The same experiments carried out at pH 4.3 and 6.8 showed a low increase of k sub N between pH 4.3 and 5.6. However, k sub N increased in fact at pH 6.8. This phenomenon is probably the consequence of the decomposition of ozone in water at neutral pH. The kinetic study made at different temperatures allowed determination of the value of the activation energy (E sub a approximately equal to 8 kcal/mol at pH at 5.6). So, the value of the rate constant at 20 C and pH 5.6 (k sub N approximately equal to 1500 l/mol/s) is practically the same as the previously mentioned values when the reaction is carried out at 20 C with pH 2 in presence of radical scavengers. Finally, the rate constant values of 1-chloro naphthalene and 2-methyl naphthalene, allowed us to predict that the initial attack of ozone on 1,2 bond of naphthalene is of an electrophilic nature. (See also w86-04126) (Author's abstract)
W86-04127

INVESTIGATIONS INTO THE SCOPE AND LIMITATIONS OF THE BISMUTH ACTIVE SUBSTANCES PROCEDURE (WICKBOLD) FOR THE DETERMINATION OF NONIONIC SURFACTANTS IN ENVIRONMENTAL SAMPLES,
Unilever Research Port Sunlight Lab. (England).
For primary bibliographic entry see Field 5A.
W86-04131

PREDICTION OF MULTICOMPONENT ADSORPTION EQUILIBRIA USING IDEAL ADSORBED SOLUTION THEORY,
J. C. Crittenden, P. Luft, D. W. Hand, J. L. Oravita, and S. W. Loper.
Environmental Science and Technology ESTHAG, Vol. 19, No. 11, p 1037-1043, November 1985. 6 fig, 3 tab, 26 ref. NSF Grant Nos. CEE-7924589 and CEE-8300213.

Descriptors: *Adsorption, *Organic compounds, *Mathematical studies, *Activated carbon, Separation techniques, Error analysis, Water treatment, Wastewater treatment, Organic wastes, Organic carbon, Prediction, Chemical reactions, Theoretical analysis, Ideal Adsorbed Solution Theory, Chloroform, Bromoform, Trichlorethene, Tetrachloroethene, Chlorodibromomethane, Freundlich equation.

The capability of ideal adsorbed solution theory (IAST) to predict multicomponent competitive interactions between the following volatile organic chemicals was tested: chloroform, bromoform, trichloroethene, tetrachloroethene, 1,2-dibromoethane, and chlorodibromomethane. A total of seven mixtures that contained various combinations of two, three, and six solutes were tested for three commercially available activated carbons. The predictions were satisfactory for the 256 isotherm data that were collected. An error analysis was performed for various isotherms that are used to represent single solute data in IAST calculations. This analysis demonstrated that the Freundlich equation was sufficiently accurate in representing the data under certain simplifying assumptions, and the use of the Freundlich equation in IAST calculations resulted in a relatively straightforward expression to describe the multicomponent data. The multicomponent data for the mixtures were plotted as total organic halogen and total organic carbon, and, when the mixture data were plotted in this manner, appeared to behave as a pseudo single solute. (Author's abstract)
W86-04136

ROLE OF COAGULATION IN THE KINETICS OF SEDIMENTATION,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
K. J. Farley, and F. M. M. Morel.
Environmental Science and Technology, Vol. 20, No. 2, p 187-195, February 1986. 14 fig, 2 tab, 21 ref, append. NOAA Grant NA79AA-D-00077 and EPA Grant CR-811181-01-01.

Descriptors: *Coagulation, *Kinetics, *Sedimentation, Differential settling, Shear, Brownian motion, Power law relationships.

The combined results of analytical, numerical, and laboratory studies are used in examining the kinetic behavior of sedimentation in well-mixed systems. The rate of mass removal of solids, dC/dt, as a function of mass concentration C, can be described as the sum of three power laws, dc/dt = -B sub dsC(2.3) - B sub shC(1.9) - B sub bC(1.3), each term of which corresponds to a settling, shear, and Brownian motion. Empirical relationships for the coefficients B sub ds, B sub sh, and B sub b as a function of system parameters are provided. Laboratory rate coefficients for seawater experiments compare reasonably well with our rate coefficient relationships for collision efficiencies ranging from 0.2 to 1.0. Additional work on floc porosity and collision efficiencies however is needed. In applying the proposed power law removal equation to field conditions, only the differential settling term and the shear term are expected to be important. Removal rates could therefore be approximated reasonably well by a second-order expression. However, it should be emphasized that (whether by direct calculations from system parameters or by extrapolation from laboratory observations) the proposed power law relationship provides a better estimation of removal rates. Finally, in applying these results, particularly for the case of ocean disposal, questions concerning initial sedimentation behavior, mixing depths, and vertical mass concentration gradients should be addressed. (Lantz-PTT)

W86-04229

SELECTIVE RECOVERY OF GOLD AND OTHER METAL IONS FROM AN ALGAL BIOMASS,
New Mexico State Univ., Las Cruces. Dept. of Chemistry
For primary bibliographic entry see Field 5B.
W86-04231

OCCURRENCE, GROWTH, AND SUPPRESSION OF SALMONELLAE IN COMPOSTED SEWAGE SLUDGE,
Maryland Environmental Service, Annapolis.
For primary bibliographic entry see Field 5E.
W86-04234

OCCURRENCE OF MULTIPLE-ANTIBIOTIC-RESISTANT ENTERIC BACTERIA IN DOMESTIC SEWAGE AND OXIDATION LAGOONS,
North Dakota Univ., Grand Forks. Dept. of Microbiology and Immunology.
M. V. Walter, and J. W. Vennes.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 930-933, October 1985. 2 fig, 3 tab, 19 ref.

Descriptors: *Coliforms, *Sewer Systems, *Oxidation Lagoons, *Grand Forks, North Dakota, Antibiotics, Public Health, Water Quality Standards, Microorganisms, Bacterial Analysis.

The coliform bacterial population in the Grand Forks, N. Dakota sewage system was examined for multiple-antibiotic-resistant organisms over a 1 year period. Multiple-antibiotic-resistant coliforms were common in the sewage, and their numbers remained fairly constant relative to the total coliform population throughout the year. Resistance to kanamycin, tetracycline, and ampicillin was transferable at variable rates. Transfer rates were temperature sensitive and were optimal at 35 C. Although 75% of the multiple-antibiotic-resistant coliforms were capable of transferring resistance at rates >0.001 transconjugants per initial donor, the results indicate that if total coliform levels are kept within prescribed standards, the multiple-antibiotic-resistant coliform levels will be reduced to a level at which they will probably not pose a major health hazard. (Author's abstract)
W86-04235

FERMENTATIVE AND OXIDATIVE TRANSFORMATION OF FERULATE BY A FACULTATIVELY ANAEROBIC BACTERIUM ISOLATED FROM SEWAGE SLUDGE,
Stanford Univ., CA. Dept. of Civil Engineering.
D. Grbic-Galic.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 1052-1057, October 1985. 4 fig, 26 refs. NSF CEE 84-04369.

Descriptors: *Aromatic Compounds, *Sludge, *Anaerobic Bacteria, *Ferulate Biodegradation, Lignin, Enterobacter, Microbiological Studies, Baterial Analysis.

A facultatively anaerobic, gram-negative, nonsporeforming, motile rod-shaped bacterium was isolated from methanogenic consortia degrading 3-methoxy-4-hydroxycinnamate (ferulate). Consortia were originally enriched from a laboratory anaerobic digester fed sewage sludge. In the absence of exogenous electron acceptors anaerobic conditions (N2-CO2 gas phase). Ferulate (1.55 mM) was demethoxylated and dehydroxylated with subsequent reduction of the side chain, resulting in production of phenylpropinate and phenylacetate. Under aerobic conditions, the substrate was completely degraded, with transient appearance of caffeate as the first aromatic intermediate and beta-ketoadipate as an aliphatic intermediate. The pure culture has been tentatively assigned to the genus Enterobacter with the type strain DG-6. (Author's abstract)
W86-04237

SELECTIVE MEDIUM FOR THE ISOLATION OF OPPORTUNISTIC FLAVOBACTERIA FROM POTABLE WATER,
National Hansen's Disease Center, Carville, LA.
For primary bibliographic entry see Field 5F.
W86-04239

EFFECT OF CALCIUM ION ON SLUDGE CHARACTERISTICS,
Utsunomiya Univ. (Japan). Dept. of Environmental Chemistry.
K. Kakii, S. Kitamura, T. Shirakashi, and M. Kuriyama.
Journal of Fermentation Technology, Vol. 63, No. 3, p 263-270, June 1985. 7 fig, 3 tab, 11 ref.

Descriptors: *Activated sludge, *Calcium, *Metals, *Flocculation, *Wastewater treatment, Aluminum, Iron, Magnesium, Zinc, Manganese, Sludge, Sludge thickening.

Concentrations of the metals in sewage activated sludge were examined over a 1-yr period. The sludge contained relatively large amounts of calcium (14-16 mg/g suspended solids), aluminum (11-28 mg/g SS), and iron (11-30 mg/g SS). The relative contents of the metals in the sludge decreased in the following order: Fe>Al>Ca>Mg>Zn>Mn. The solution of mixed liquor in the aeration tank contained relatively high concentrations of Ca(++) (17-23 mg/l) and low concentrations of Mg(++) (3-6 mg/l). Most of the calcium in sewage activated sludge was easily extracted with weak acid (pH 3) but little iron and aluminum were extracted under the same conditions. Therefore, the acid-treated sludge was used to examine the effect of Ca(++) on sludge characteristics. With increasing amounts of Ca(++) added, 30-min settled sludge volume and the turbidity of the supernatant after 30-min settling decreased. The maximum amount of Ca(++) bound to the acid-treated sludge was nearly equal to the amount of Ca(++) extracted by the acid treatment. These results indicated that Ca(++) binds to sludge surface materials and plays an important role not only in flocculation in sewage activated sludge but also in determining sludge characteristics such as thickness. (Author's abstract)
W86-04247

COMPOSTING REACTION RATE OF SEWAGE SLUDGE IN AN AUTOTHERMAL PACKED BED REACTOR,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
For primary bibliographic entry see Field 5E.
W86-04248

CHANNEL FLOW SYSTEM FOR WASTEWATER TREATMENT AND FOOD PRODUCTION,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
S. Hashimoto, K. Furukawa, and Y. Ozaki.
Journal of Fermentation Technology, Vol. 63, No. 4, p 343-356, August 1985. 12 fig, 11 tab, 19 ref.

Descriptors: *Aquatic Plants, *Wastewater Treatment, *Fish Harvest, Tilapia, Pah-Bungh, Organic Carbon, Nitrogen Removal, Phosphorus Removal, Biological Wastewater Treatment.

Research was conducted on a channel flow wastewater treatment system which uses a natural hydraulic head and incorporates Tilapia and Pak-Bung for the simultaneous removal of total organic carbon (TOC), total nitrogen (T-N), and total phosphorus (T-P). Treatment of diluted synthetic wastewater at a surface loading rate of 0.16-0.66 g/sq m/day and synthetic night soil resulted in mean TOC, T-N, and T-P removal of >90%, 14-43% and 7-58%, respectively with a retention time of 2.8 days. Under optimum conditions, the crop yield of Pak-Bung was maintained at 1.5 kg/week/3.15 sq m and the harvested Pak-Bung contained abundant vital amino acids and vitamins. The crop yield was strongly influenced by water and atmospheric temperature and light intensity. When these conditions were satisfied artificially in winter, crop yield was maintained at 1.2 kg/week/3.15 sq m. Tilapia showed satisfactory growth in water channels without feeding at temperatures of 23.5 C and higher with net-type contact materials. These results indicate the benefit of channel flow treatment with Pak-Bung and Tilapia for simultaneous advanced wastewater treatment and food production. (Peters-PTT)
W86-04249

RESPONSE OF ACTIVATED SLUDGE PROCESS TO STEPWISE SHORTENING OF BIOLOGICAL SOLIDS RETENTION TIME,
Himeji Inst. of Tech. (Japan). Dept. of Chemical Engineering.
S. Hasegawa, K. Fukui, Y. Maeda, and M. Nakajima.
Journal of Fermentation Technology, Vol. 63, No. 4, p 357-362, August 1985. 7 fig, 2 tab, 14 ref.

Descriptors: *Activated Sludge Process, *Retention Time, *Sludge Volume Index, Microbiological Studies, Bacterial Analysis, Microorganisms, Nitrification, Hydrogen Ion Concentration.

Laboratory experiments were made to examine the effects of stepwise shortening of the biological solids retention time (SRT) on microbial aspects of activated sludge growing on an artificial wastewater containing starch and peptone as carbon and nitrogen sources, respectively. SRT was controlled automatically by intermittent drawing of the mixed liquor, and was suddenly changed from 20 to 15, 10 and 5 days. The value of sludge volume index (SVI) increased with the shortening of the SRT. Microscopic observations revealed that the high SVI was caused by excessive filamentous bacteria of Types 0961 and 1701 in Eikelboom's classification. Type 0961 is characterized by slightly bent, multicellular, unbranched, Neisser-negative and Gram-negative filaments. The cylindrical cells have a uniform diameter of 1.1-1.4 micro m. Type 1701 is a sheath-forming, Neisser-negative and Gram-negative organism with a clearly visible septa and a diameter of 0.7-0.9 micro m. Wastewater with a high C/N ratio favored filamentous growth. When the content of nitrogen source was raised, filamentous growth was suppressed apparently by active nitrification accompanied by a considerable drop of the mixed liquor pH. (Peters-PTT)
W86-04250

SELECTIVE DETECTION AND ENUMERATION OF FECAL COLIFORMS IN WATER BY POTENTIOMETRIC MEASUREMENT OF LIPOIC ACID REDUCTION,
Laboratoire Municipal d'Hygiene, Le Havre (France).
For primary bibliographic entry see Field 5A.
W86-04252

PHYSICAL AND CHEMICAL CORRELATES OF MICROBIAL ACTIVITY AND BIOMASS IN COMPOSTING MUNICIPAL SEWAGE SLUDGE,
Cincinnati Univ., OH. Dept. of Biological Sciences.
V. L. McKinley, and J. R. Vestal.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1395-1403, December 1985. 2 fig, 5 tab, 40 ref. EPA Grant CR-807852-01-0.

Descriptors: *Biomass, *Sludge Disposal, *Municipal Wastes, *Microbial Degradation, *Composting, Chemical Properties, Physical Properties, Temperature, Moisture Content, Hydrogen Ion Concentration, Proteins, Organic Carbon, Nitrogen Compounds, Lipids, Phosphates, Bacterial Analysis.

Various physical and chemical parameters were monitored to evaluate their influence on the microbial communities present in composting municipal sewage sludge. Temperature, moisture content, depth, pH, protein content, total nitrogen, total carbon, lipid phosphate biomass, and the rates of microbial incorporation of substrates into lipids were measured at several times throughout the 17-

to 19-day composting runs. Temperature had the most consistent and dramatic effect on microbial activity and biomass. When temperatures exceeded 55-60 C, microbial activity fell dramatically, usually by more than 1 order of magnitude. Microbial activity was generally greatest in samples taken from the 35-50 C areas of the composting piles. Changes in the composition of the compost over time included increased pH, increased protein content, and decreased total organic content. The changes in these parameters appeared to reflect the microbial activity and biomass present. The results indicate that the rate of composting may best be optimized by controlling the composting temperatures, provided that the other parameters fall within reasonable limits in the starting material. (Author's abstract)
W86-04254

EFFECT OF TEMPERATURE ON COMPOSTING OF SEWAGE SLUDGE,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
For primary bibliographic entry see Field 5E.
W86-04259

NUTRIENT REMOVAL POTENTIAL OF SELECTED AQUATIC MACROPHYTES,
Central Florida Research and Education Center, Sanford, FL.
For primary bibliographic entry see Field 5G.
W86-04262

TRACE ANALYSIS OF THIOSULFATE IN CORRODED CONCRETE SEWERS BY DIFFERENTIAL-PULSE-ANODIC-STRIPPING VOLTAMMETRY,
Hamburg Univ. (Germany, F.R.). Inst. fuer Physikalische Chemie.
D. Knittle, P. Valenta, M. Aydin, and W. A. Konig.
Fresenius Z Anal Chem, Vol. 322, No. 6, p 581-582, November 1985. 2 fig, 13 ref.

Descriptors: *Corrosion, *Electrochemistry, *Pipes, *Sulfates, *Thiobacillus, *Pipelines, *Corrosion, Electrodes, Sewers, Trace levels, Sewer systems.

Thiosulfate, a potential substrate for sulfuric acid forming thiobacilli, could be detected and quantitatively determined in corroded concrete sewer systems by differential pulse anodic-stripping voltammetry (DPASV). The principle of this technique is based on the possibility of obtaining an ambiguous electrical signal specific for the presence of thiosulfate ions by reduction, adsorption on a Hg surface and oxidation of these ions. Cathodic polarization of a hanging Hg drop causes enrichment of a reduced sulfur species at the Hg surface which is oxidized at a more positive potential. Samples of dried corroded concrete sewage pipes are extracted with bidistilled H2O and filtered before DPASV determination. Sodium acetate buffer in a polarographic cell serves as basic electrolyte. The method proved to be specific and gave reproducible results for concentrations from 5 ppb to 3 ppm of thioshiosulfate in aqueous media. (Geiger-PTT)
W86-04284

SECRETS TO THE SUCCESS OF ANAEROBIC DIGESTION,
Manhattan Coll., Bronx, NY. Environmental Engineering and Science Program.
J. S. Jeris, and I. J. Kugelman.
Water Engineering and Management, Vol. 132, No. 7, p 32-35, July 1985. 3 fig, 2 tab.

Descriptors: *Anaerobic digestion, *Wastewater treatment, *Anaerobic conditions, *Process control, Hydrogen ion concentration, Temperature, Biological wastewater treatment, Sludge digestion, Digestion, Stage digestion, Mixing, Fermentation, Training.

With proper operation and maintenance attention, the anaerobic digestion process in wastewater treatment need not be difficult to control. pH and alkalinity must be controlled in a narrow range. This is usually done by buffering. If the waste material does not contain alkaline compounds, or precursors of alkaline compounds, these must be added to maintain the pH in the correct region. Alkalinity is often added to the system by the use of sodium or potassium bicarbonate. Temperature must also be strictly controlled. Mixing, another essential feature in anaerobic digesters, is accomplished by gas recirculation or mechanical methods. The tests that should be periodically performed on raw and digested sludge to provide optimum functioning of the anaerobic digestion system are listed. Gas production and composition measurements are important in detecting upsets to the system. Digester failure incidents can also be drastically reduced by operator training. (Geiger-PTT)
W86-04288

MILE-DEEP REACTOR DESTROYS SLUDGE WITH EASE,
Vertech Treatment Systems, Denver, CO.
For primary bibliographic entry see Field 5E.
W86-04289

COMPUTER ASSIST FOR ACTIVATED SLUDGE PROCESS,
Clemson Univ., SC. Dept. of Environmental Systems Engineering.
H. S. Keck, T. M. Keinath, and S. C. Stratton.
Water Engineering and Management, Vol. 132, No. 10, p 30-33, 36, 37, September 1985. 7 fig, 4 ref.

Descriptors: *Wastewater treatment, *Computer programs, *Computers, *Activated sludge process, *Biological wastewater treatment, Suspended solids, Process control, Automation, Systems engineering, Activated sludge.

A computer program was developed using BASIC language and an IBM PC microcomputer system to aid in the control of the activated sludge process of wastewater treatment facilities. The software system developed consists of three major programs and two data files: a master maintenance program, a solids inventory/SRT control program, an optional graphical display program, a master data file, and a previous input parameter data file. Relatively permanent information is entered into the system through the master maintenance program. Such data includes available recycle pumping flow rate, desired solids retention time, system of units, selected recycle control strategy, average influent flow rate, location of wasting point, method of wasting and aeration basin volume. Mathematical analysis of the operating state of a clarifier is performed by the solids inventory control program to establish the loading condition and generate recommendations for any change in recycle and/or wasting flow rates. The system was tried at the Coneross Creek Wastewater Treatment Facility near Seneca, South Carolina, from June through August, 1981. A dramatic reduction in both the mean concentration as well as the variability of effluent total suspended solids was observed after teh inception of the computer-assisted control strategy during May. In addition to this activated sludge/clarifier control program, seven other software programs have been developed at Clemson University to assist in the operation and management of wastewater and notable water treatment facilities. (Geiger-PTT)
W86-04290

MAKING EFFECTIVE USE OF EXISTING COLLECTION CAPACITY,
RJN Environmental Associates, Inc., Wheaton, IL.
R. E. Nelson, and R. J. Jogaj.
Water Engineering and Management, Vol. 132, No. 10, p 38-40, September 1985. 3 fig, 1 tab.

Descriptors: *Sewer systems, *Sewers, *Relief sewers, *Computers, Sewer districts, Sewer hydraulics, Evaluations, Cost analysis, Flow pattern, Project planning.

Determining relief transport capacity requirements is an important consideration in evaluating improvement alternatives for wastewater collection systems. Computer-assisted engineering analysis techniques such as the Sewer System Evaluation (SSEM) can be used to evaluate alternatives such as parallel relief sewers and rerouting relief sewers. Selection of the least-cost sewer routing approach is usually the preferred method. Steps for flow rerouting analysis include identifying overloaded sewers, selecting rerouting alternatives, creating new sewers in SSEM model, performing computer capacity analysis, and analyzing outputs. For fewer lines slightly overloaded during peak flow events, the feasibility of transporting flow existing sewer lines under surcharge conditions must be considered by evaluating sewer elevation, sewer size, surface elevation, and basement elevation. Projects that have realized cost savings as a result of a computerized capacity analysis include the City of Lockport, the Village of Hoffman Estates, and the County Farm Road Area of the Wheaton Sanitary District, all of northeastern Illinois. To optimize a relief sewer plan, the considerations that should be evaluated include flow rerouting, transport of peak flow with surcharge, and parallel or replacement sewers. (Geiger-PTT)
W86-04291

SAGGING SEWERS: A SERIOUS PROBLEM GETTING WORSE,
South Stickney Sanitary District, Burbank, IL.
S. Chatterjee, and F. DeCarlo.
Water Engineering and Management, Vol. 132, No. 10, p 42-44, September 1985. 3 fig, 4 ref.

Descriptors: *Sewers, *Sewer systems, *Pipelines, Pipes, Sewer hydraulics, Clogging.

Sanitary sewer pipelines can sometimes develop sags (or dips) as a result of faculty design, construction or maintenance of the wastewater collection system of which they are a part. The primary causes of sewer sag are: poor bedding/foundation, poor haunching, improper backfill, poor pipe material, loading conditions, embankment strength, dewatering of the trench, railroad crossings, stream crossings, and traffic arteries. A significant sag can cause a serious crack or rupture, and/or collapse of the pipe at the crown as well as along the spring line or side. This may create a trap for solids, floating materials, grease, and other materials, or create instabilty in the backfill and potential for clogging due to mud-slide. Long term effects of sags range from gradual decay and collapse to frequent blockage, back ups and even blowups at certain locations in the collection system. Measures that would help prevent sagging are thorough foundation investigations during construction, properly conducted compaction and bearing tests for the final bedding at selected locations, possibly every 100 ft, and finally, proper compaction tests for haunching materials in every sewer construction or rehabilitation project. (Geiger-PTT)
W86-04292

DESIGN CONSIDERATIONS FOR CERAMIC FINE BUBBLE GRID DIFFUSER SYSTEMS,
Houck (D.H.) Associates, Inc., Silver Spring, MD.
D. H. Houck.
Water Engineering and Management, Vol. 132, No. 8, p R8-R13, July 1985. 5 fig, 17 ref.

Descriptors: *Aeration, *Aerators, *Wastewater treatment, *Design criteria, Cost analysis, Maintenance, Bubbles, Mixing, Dissolved oxygen.

With rising cost for energy, there has been an increasing interest in North America and Europe in more efficient aeration systems. The design and operation of ceramic fine bubble dome and disk diffuser systems is examined in relation to their use at wastewater treatment facilities. The performance of fine bubble diffusers is measured by oxygen transfer efficiency. Process considerations that influence their performance include plant influent characteristics, treatment plant processes, and loading conditions. Sliming or bio-fouling may occur at plants treating specific wastes. Higher loading rates need not cause decreased efficiency if the loads are accounted for in design. Aereation tank design is important in achieving proper aer-

ation and mixing. The number of diffusers needed to supply the required air flow rate is determined by the air flow rate per diffuser and system flexibility. Correct diffuser distribution within the tank is also important for proper aeration. Proper installation of ceramic grid diffuser systems is necessary to prevent damage to equipment. System performance can be tracked through mass balance measurements of system oxygen demand and measurements of air flow and power consumption. Aeration power consumption may be reduced 40 to 50% when converting from coarse bubble equipment to a ceramic grid diffuser system, and maintenance costs are only increased moderately if sound preventive maintenance is practiced. (Geiger-PTT)
W86-04293

SLUDGE MANAGEMENT METHOD GETS UPDATED,
Black and Veatch, Kansas City, MO.
For primary bibliographic entry see Field 5E.
W86-04298

PILOT STUDIES INDICATE COMPOSTING CHOICES,
Camp, Dresser and McKee, Inc., Boston, MA.
For primary bibliographic entry see Field 5E.
W86-04299

SMALL PLANT CAPTURES GAS ECONOMICALLY,
Lakeville Sewage Treatment Plant, NY.
G. Herington.
Water Engineering and Management, Vol. 132, No. 13, p 32-34, December 1985. 2 tab.

Descriptors: *Methane, *Cost analysis, *Recycling, *Wastewater treatment, Wastewater facilities, Storage tanks, Anaerobic digestion.

Although many small municipal wastewater treatment plants have methane gas available from anaerobic digestion, few can use it effectively due to the high price of gas storage systems. The Lakeville, New York treatment plant typified this situation until it acquired a used gas storage tank and installed a gas collection system for under $40,000. The system features a water-ring compressor that draws methane from the existing accumulator when pressure in the accumulator reaches 6 in. in the water column, and shuts it off when it drops to 3 in. The shrouded rotor swirls a ring of water in an oval chamber, and water alternately fills and empties the spaces between the rotor blades with the effect of pistons. The water removes such pollutants as hydrogen sulfide and absorbs the heat of compression. The system will pay for itself in 4.5 yr of operation and contribute to savings in oil usage. (Geiger-PTT)
W86-04300

CHEMICAL BID PACKAGE CUTS COSTS, IMPROVES CONTROL,
Manatee County Water Treatment Plant, Bradenton, FL.
J. J. Clune.
Water Engineering and Management, Vol. 133, No. 1, p 25, 28-30, January 1986. 1 fig, 2 tab.

Descriptors: *Wastewater treatment, *Water treatment, *Coagulants, *Cost analysis, *Disinfectants, Chemical treatment, Lime, Sulfates, Costs, Activated carbon, Odor control, Color, Ammonia, Chlorine.

A methodology for the chemical bid process has been developed and is currently used by the Manatee County Public Utilities System water treatment section in southwestern Florida. The utility solicits yearly bids from a selected list of some 55 vendors who have made on-site investigations of plant needs and can demonstrate the ability to satisfy the plant's accounts. The water treatment section of the bid package places all chemicals into six major groups: coagulants, coagulant aids, pH control chemicals, taste and odor control chemicals, corrosion inhibitors and disinfectants. Three coagulants - aluminum sulfate, ferric sulfate and ferric chloride - have proven effective at the Manatee plant. Vendors are required to submit bids on a price-per-pound (Al3+) or Fe(3+) basis. Bid ratios are then applied to the quoted price to establish cost effectiveness. Each product has a comprehensive written specifications which contains product quality minimums, shipping restrictions, minimum concentrations and other chemical requirements. A screening process is used to limit the number of coagulant aids that may be bid on. pH control chemicals such as lime are assessed a 2% monetary penalty for each 1% that the product falls below the 92% available CaO standards. For taste and odor control, research is underway which will allow for the establishment of bid ratios based on geosmin and 2-methylisoborniol adsorption rates for all activated carbons to be bid upon. Bid practices for corrosion inhibitors and disinfectants are discussed. (Geiger-PTT)
W86-04301

EVALUATION OF CONVENTIONAL TREATMENT PROCESSES FOR REMOVAL OF MUTAGENIC ACTIVITY FROM MUNICIPAL WASTEWATERS,
Health Effects Research Lab., Cincinnati, OH.
J. R. Meier, and D. F. Bishop.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 999-1005, October,1985. 7 fig, 3 tab, 14 ref. 63-08-2977.

Descriptors: *Wastewater treatment, *Toxicity, *Municipal wastewater, *Chlorination, Organic compounds, Primary wastewater treatment, Wastewater analysis, Bioassays, Effluents, Salmonella, Raw wastewater, Water pollution effects.

The ability of conventional wastewater processes to remove mutagenicity from municipal wastewaters was studied at the Mill Creek and Muddy Creek Treatment Plants in Cincinnati, Ohio, and at the EPA Test and Evaluation Facility adjacent to Mill Creek Plant. Composite samples of raw wastewater, primary and secondarily treated wastewater from the facilities were tested for mutagenicity using the Ames test. Cytotoxicity of wastewater extracts to bacteria used in the Ames test decreased markedly following secondary treatment. Chlorination of the secondary effluent had little influence on either the level of extractable organics or on the specific mutagenicity for strains TA98, but it did seem to significantly increase the TA 100 mutagenicity levels. Additional bacterial strains were included in the testing for one of the secondary effluent extracts to examine strain specifically for mutation induction. The influence of S9 on mutagenicity levels of the extracts varied greatly between samples. Comparisons of total mutagenic activities associated with the different treatments showed that the overall removal of mutagenic activity during treatment varied among test series from no removal to a reduction of as much as two-thirds of the activity. The only detectable mutagenic activity in the primary effluent was found in the acid/neutral fraction. For the secondary effluent, the highest specific mutagenic activity was associated with the base fraction. (Geiger-PTT)
W86-04330

FACTORS CONTROLLING SENSITIVITY IN ULTRAVIOLET DISINFECTION OF SECONDARY EFFLUENTS,
Georgia Univ., Athens. Inst. of Ecology.
R. G. Qualls, S. F. Ossoff, J. C. H. Chang, M. H. Dorfman, and G. M. Dumais.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1006-1011, October 1985. 3 fig, 4 tab, 21 ref. EPA Grant R809593010, NSF Grant CEE82-05274.

Descriptors: *Disinfection, *Ultraviolet radiation, *Biological wastewater treatment, *Effluents, *Particulate matter, Coliforms, Suspended solids, Particle size, Turbidity, Water quality, Wastewater composition, Wastewater treatment, Chemical oxygen demand, Filtration.

Samples of unchlorinated secondary effluent were gathered on six occasions from each of five municipal wastewater treatment plants to use in studying the dosage of ultraviolet (UV) light needed for disinfection and to quantify the role of the number and size distributions of suspended particles in determining the differences in UV sensitivity in the effluents. The survival of the coliforms as a function of UV dose was determined by irradiating samples in a small petri dish with stirring in a collimated beam of UV light using four low pressure mercury lamps. The dose required to yield -2 log survival units was a mean value of 6.5 mW-sec/sq cm for the unfiltered samples and a mean value of 5.7 mW-sec/sq cm for the 10-micron filtered samples. The data at a dose of 26 mW-sec/sq cm was used to analyze the variation between samples caused by particles in unfiltered samples. Results showed that the number of surviving coliform at this dose was roughly correlated with the number of suspended particles >40-microns in diameter. Number and size of particles are directly related to survival, but a more easily measured surrogate parameter such as solids concentration or turbidity would be more practical. A multiple regression using both COD and turbidity as independent variables gave a good prediction of UV absorbance. The average survival curves of coliform generated in this study may be useful to plan equipment needs for UV disinfection of wastewater treated by biological floc formation. (Gieger-PTT)
W86-04331

START-UP OF A HIGH-PURITY, OXYGEN-ACTIVATED SLUDGE SYSTEM AT THE LOS ANGELES COUNTY SANITATION DISTRICTS' JOINT WATER POLLUTION CONTROL PLANT,
Los Angeles County Sanitation District, CA.
R. Wunderlich, J. Barry, D. Greenwood, and C. Carry.
Journal of the Water Pollution Control Federation, Vol.57, No. 10, p 1012-1018, October, 1985. 4 fig, 5 tab, 2 ref.

Descriptors: *Wastewater treatment, *Wastewater facilities, *Activated sludge process, *Anaerobic digestion, *Sludge thickening, Sludge drying, Dewatering, Training, Process control, Design criteria.

In 1976, an 8.77 cu m/sec high-purity oxygen activated sludge secondary treatment facility was constructed at the Joint Water Pollution Control Plant in Carson, California to comply with federal and state discharge requirements. Phase 1 of the start-up consisted of writing manuals for operation and maintenance and for training. Phase 2 involved equipment testing and began early in 1981. Some of the tests conducted were: leakage for all tanks, head versus capacity performance tests for pumps, vibration analyses and alignment checks for all rotating equipment, power consumption/efficiency tests for all large energy users, detailed noise analyses for large rotating equipment and cryogenic oxygen generation plants, and performance tests for biological reactors and dissolved air flotation unit. Phase 3 required staffing for the biological system, one cryogenic oxygen plant and the secondary effluent pump station. Phase 4 involved in-house training for the activated sludge process which was conducted by the districts' staff and supplemented with vendor training on flotation thickening, cryogenic oxygen generation, pumps, and other systems according to contract specifications. Process evaluations in Phase 5 showed that the plant produces the effluent quality expected at different flows under a variety of operating conditions. Sludge production and oxygen consumption were in line with predicted values. The digestion and dewaterability of different combinations of waste activated and primarily sludge will be studied for possible use in future operations. (Geiger-PTT)
W86-04332

IMPROVEMENT OF ACTIVATED SLUDGE FILTERABILITY,
Pittsburgh Univ., PA. Dept. of Civil Engineering.
Y. C. Wu, O. J. Hao, and K. C. Ou.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1019-1021, October, 1985. 4 fig, 1 tab, 6 ref. EPA Grant No. R807600-01.

Descriptors: *Activated sludge process, *Filtration, *Activated sludge, *Wastewater composition, *Biochemical oxygen demand, Microorganisms, Sulfates, Alum, Dewatering, Setteable solids, Sludge drying, Sludge conditioning, Wastewater treatment.

This study investigated the effects of reactor compartmentalization and growth condition on sludge dewaterability. The optimum dose of chemical conditioning agents (alum and ferric sulfate) for improving the filtering properties of activated sludge cultivated under various growth environments was also determined. It was concluded that the specific resistance of waste activated sludge is not only a function of wastewater characteristics such as BOD:N, operating parameters such as food-to-microorganism ratio (F/M) and sludge age, DO concentration, but also reactor configuration or DN (dispersion number). The specific resistance of the activated sludge generally decreased or the dewaterability of the activated sludge increased as the DN of the aerated bioreactor decreased under nitrogen-rich growth conditions when DO was not limiting. DO and nitrogen restrictions in an aeration tank associated with high DN caused overproduction of longer filamentous organisms in the activated sludge culture, and in turn, poor sludge settling or high specific resistance. Specific resistance could be reduces by adding chemical conditioner; the reduction was greater when the initial specific resistance was higher. The dewatering characteristics of the activated sludge were related to sludge settleability; the lower the sludge volume index (SVI), the lower the specific resistance. Under the nitrogen-limited growth condition, the specific resistance of the activated sludge was directly proportional to the SVI. (Geiger-PTT)
W86-04333

INFLUENCE OF WASTE ACTIVATED SLUDGE ON PRIMARY CLARIFIER OPERATION,
Winnipeg City Waterworks (Manitoba). Waste and Disposal Dept.
R. D. Ross, and G. V. Crawford.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1022-1026, October, 1985. 1 fig, 5 tab, 1 ref.

Descriptors: *Wastewater treatment, *Activated sludge process, *Clarification, *Clarifiers, *Organic carbon, Suspended solids, Biochemical oxygen demand, Activated sludge, Sludge thickening, Effluents, Sludge drying, Dewatering.

Tests were carried out at the North End Water Pollution Control Center (NEWPCC) in Winnipeg, Manitoba, Canada to determine the primary sludge total solids concentration with and without the effects of the waste activated sludge sidestream, to compare the primary sludge concentration from a circular primary clarifier with that from a rectangular primary clarifier when both were operated without the waste activated sludge sidestream, and to monitor any difference in the biochemical oxygen demand (BOD), total organic carbon (TOC), and suspended solids (SS) concentrations of the effluents from the primary clarifiers being studied. With circular clarifiers of identical configurations, the separation of waste activated sludge from the primary clarification process at the NEWPCC resulted in a more concentrated primary sludge. With identical operating parameters and without the co-thickening of waste activated sludge, no difference was found between the primary sludge (underflow) concentration of a circular versus rectangular primary clarifier. The differences in primary effluent (overflow) SS concentrations between the three clarifiers, although statistically significant, were small relative to the variations in day-to-day concentrations. The difference in the primary effluent (overflow) BOD and TOC concentrations were not statistically significant. Since peak flows were not experienced during the test period, the effects of waste activated sludge addition during peak clarifier flow conditions were not examined . (Geiger-PTT)
W86-04334

ELIMINATION OF ODOR AT SIX MAJOR WASTEWATER TREATMENT PLANTS,
Hampton Roads Sanitation District, Norfolk, VA.
G. D. Waltrip, and E. G. Snyder.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 1027-1032, October, 1985. 5 fig, 1 tab, 7 ref.

Descriptors: *Odor control, *Odors, *Wastewater treatment, *Wastewater facilities, *Design criteria, Chlorination, Chemical treatment, Sulfates, Aeration, Sodium hydroxide, Cost analysis.

A two year study by Hampton Roads Sanitation District was conducted to examine methods to eliminate off-site plant odors resulting from a force main collection system. Results showed that hydrogen peroxide addition was effective but very expensive. Ferrous sulfate addition was expensive and poor in performance. Upline chlorination and bacterial culture addition were not effective. Prechlorination was effective, but unattractive because of chemical cost and supply limitations. , Pre-aeration oxidized 80% of the influent sulfides; the remaining 20% are released with the air stream. Sulfides in the air stream can be removed using a packed-tower scrubber, preferrably using caustic. Based on this study, design criteria were developed and used to design odor control facilities at the six treatment plants about which odor complaints were made. Odor control was very successful at the five plants that began using the new equipment in 1983. The sixth plant is also being redesigned to meet the required criteria. (Geiger-PTT)
W86-04335

NEUTRALIZATION OF WASTEWATERS CONTAINING CYANIDES: CONCLUSION: OTHER METHODS OF CYANIDE DESTRUCTION,
Marie Curie-Sklodowska Univ., Lublin (Poland). Dept. of Environmental Chemistry and Technology.
R. Gierzatowicz, L. Pawlowski, and E. Smulkowska.
Effluent and Water Treatment Journal, Vol. 26, No. 2, p. 51-52, 54, February 1986. 12 refs. Continued from Vol. 26, No. 1, p 26-31.

Descriptors: *Chlorination, *Oxidation, *Thermal decomposition, *Saponification, *Electrochemical oxidation, *Ion exchange, *Irradation, *Biological decomposition, *Ozonation, *Cyan-cat method, Economics, Temperature, Pressure, Radiolysis, Electroplating, Peroxides, Chromates, Potassium permanagnate, Oxygen, Pilot plants.

Various Methods of treating industrial wastes containing cyanide are discussed, including thermal decomposition (Cyan-Cat process), conversion with aldehydes and ketones, saponification and elevated temperatures and pressures, electrochemical oxidation, ion exchange, radiolysis, and biological decomposition. The various methods have their advantages and disadvantages. The Cyan-Cat method has a very dangerous stage of hydrogen evolution. Electrochemical oxidation is economical only for concentrated solutions. Cyanide conversion with aldehydes is economical for small electroplating plants where a bath system is possible. The cost of ozonation may be very high. High temperature burning has high effectiveness and low capital and operating costs. Radiolysis is inexpensive and simple, but is limited to lower cyanide concentrations and the presence of technology for applying ionizing radiation sources. Ion exchange is unprofitable and difficult to carry out. Biological decomposition may be useful for joint community-industrial waste disposal. Cyanogenic substance oxidation with such agents as peroxides, chromates, potassium permanaganate, and oxygen has only been studied in laboratories and on a pilot plant scale. (Rochester-PTT)
W86-04341

PROCESS SELECTION FOR OIL SEPARATION,
ESMIL Water Systems, High Wycombe (Enland).
J. Ryan.
Effluent and water Treatment Journal, Vol. 26, No. 2, p. 60-63, February 1986. 4 fig, 3 ref.

Descriptors: *Oil wastes, *Dissolved oil, *Gravity separation, *Coalescence, *Flotation, *Adsorption, *Biological treatment, Oil Tankers, Surface runoff, Process waters, Oil wells, Hydrocarbons.

For the purpose of discussing oil separation techniques, oil can be considered as being present in the carrier phase as one or more of the following: free-floating oil, free oil droplets dispersed in the bulk of the carrier fluid, mechanically formed emulsions of oil in water, chemically stabilized emulsions of oil in water, and dissolved oil. Treatment techniques are gravity separation, coalescers, flotation, adsorption, and biological treatment. For an accurate prediction of an effluent quality resulting from a given process route it is essential to have a droplet size distribution together with a knowledge of the concentration and type of dissolved hydrocarbon. Sources of effluent need to be considered to assign a level of significance to the possible phases of oil. Sources include site leakage and spillage in runoff water, process waters containing oil, process waters containing significant levels of dissolved hydrocarbons, tank and tanker cleaning wastes, and produced water on an offshore production platform. A combination of experience with an application, knowing the 'history' of the carrier fluid, and a knowledge of what each type of process can achieve can lead to a satisfactory process selection. (Rochester-PTT)
W86-04342

NEW EFFLUENT TREATMENT SYSTEM AT HEATHROW AIRPORT,
Pollution Control Ltd., Telford (England).
R. J. Clark, and R. A. Walker.
Effluent and Water Treatment Journal, Vol. 26, No. 2, p. 66-69, February 1986. 1 fig, 1 tab, 2 ref.

Descriptors: *Food-processing wastes, *Dissolved air flotation, *Design, Efficiency, Reliability, Airport, Wastewater treatment, Grease, Suspended solids, Water temperature, Costs.

The new effluent treatment systems at Heathrow Airport, Great Britain, is described as a major example of employment of the dissolved air flotation technique. The mass catering center for which this facility was designed covers approximately 100,000 sq ft. Performance specifications for the plant were as follows: (1) input conditions: peak flow, 35 l/sec, average grease content, 200-600 mg/l, average solid content, 60-700 mg/l, and temperature, 25-40 C, and (2) discharge conditions (including compliance with Thames Water limits): suspended solids, 400mg/l, grease, 100mg/l, and maximum temperature, 40 C. A three stage process was specified, including pumping station, screening, and dissolved air flotation. Three factors were high on the list of priorities in the plant design: reliability, minimum manual operation, and environmental acceptability. Work on the treatment facility was completed in May 1985. Although this plant was not intended to reduce costs, its operation can be expected to result in lower expenditure on effluent disposal than previously and any restriction of effluent discharge limits by the water authority in the future would enhance such savings. (Rochester-PTT)
W86-04343

HYDROGEN AS A PROCESS CONTROL INDEX IN A PILOT SCALE ANAEROBIC DIGESTER,
Agricultural and Food Research Council, Norwich (England). Food Research Inst.
D. B. Archer, M. G. Hilton, P. Adams, and H. Wieko.
Biotechnology Letters BILED3, Vol.8, No.3, p 197-202, March 1986. 4 fig, 15 ref.

Descriptors: * Anaerobic digestion, *Hydrogen, *Biogas, *Process control, *Pilot plants, Volumetric shock loadings, Brewery effluent, Monitoring, Chemical oxygen demand, Suspended solids, Hydrogen ion concentration.

A 6 cu m pilot-scale anaerobic contact digester treating brewery effluent was subjected to four separate volumetric shock loadings and the con-

centration of hydrogen in the biogas was monitored. In 3/4 of the events there was a rapid rise in the hydrogen concentration, peaking after 3-6 hr. before declining to the normal steady -state levels. The ph remained between 6.8 and 7.1. The waste received on the day when the volumetric shock load did not induce an increase in hydrogen levels had a slightly lowered chemical oxygen demand and higher total suspended solids compared to the previous day's waste. Measurement of hydrogen has the potential to become a crucial method of process control in the operation of industrial anaerobic digesters. At present it should be regarded as a supplement to more conventional indicators of digester performance. (Rochester-PTT)
W86-04345

SELECTING PARTICLES FOR FLUIDIZED-BED BIOREACTORS WITH FLOCCULENT BIOMASS,
State Univ. of New York at Buffalo. Dept. of Chemical Engineering.
G. F. Andrews.
Biotechnology Progress, Vol. 2, No. 1, p 16-22, March 1986. 4 fig, 1 tab, 16 ref. NSF CPE 8204968.

Descriptors: *Biomass, *Flocculation, *Ethanol production, *Fluidized beds, *Anaerobic digestion, Particle size, Bioreactor, Wastewater treatment.

Designing a fluidized bed reactor for wastewater treatment of Ethanol production reduces to choosing the size and density of the support particle. Given the kinetic parameters of the biomass and the job to be done by the reactor (liquid flow rate, inlet and outlet substrate concentrations), the only variables left to be specified are the size and density of the particles in the bed. For floc particles these are fixed biologically; the designer can only select the strain with the best floc characteristics. A consideration of the mechanics of liquid fluidized beds (porosity and solid mixing) and of the effectiveness factors for biological particles enables the designer to specify types of support particles likely to maximize the reactor productivity for a particular application. Effectiveness factors for biological particles should be defined based on total volume because this gives a figure directly related to the local productivity of the reactor. For any support particle there exists a biofilm thickness that maximizes this effectiveness. (Rochester-PTT)
W86-04346

FATE OF SOLUBLE, RECALCITRANT, AND ADSORBING COMPOUNDS IN ACTIVATED SLUDGE PLANTS, II,
Henkel K.G.a.A., Duesseldorf (Germany, F.R.). Dept. of Ecology.
For primary bibliographic entry see Field 5B.
W86-04356

TREATMENT OF SOLIDS AND PETROLEUM HYDROCARBONS IN STORM RUNOFF WITH AN ON-SITE DETENTION BASIN,
Rhode Island Univ., Narragansett. Graduate School of Oceanography.
J. S. Latimer, G. L. Mills, E. J. Hoffman, and J. G. Quinn.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 548-555, April 1986, 2 fig, 4 tab, 14 ref.

Descriptors: *Hydrocarbons, *Storm runoff, *Suspended solids, Runoff, Efficiency, Storms, Parking lots, Costs.

A detention basin was assessed for its effectiveness in treating petroleum hydrocarbons, polycyclic aromatic hydrocarbons, and suspended solids from runoff at a shopping center parking lot. Treatment efficiencies varied greatly for suspended solids and for particulate and soluble hydrocarbons during the two storm events studied. Overall, they were higher for the summer storm and the particular fraction of the hydrocarbons was better treated than the soluble fraction. Negative treatment efficiency was observed for the soluble components during the spring storm, but these components represented only about 4% of the total hydrocarbons in the samples. Soluble effluent concentrations rivaled the influent concentrations during flush conditions, indicating poor treatment for soluble species during high flows. Treatment of hydrocarbons, polycyclic aromatic hydrocarbons, and suspended solids by the detention pond was 70%, 14%, and 36% better, respectively, than treatment efficiencies of a combined sanitary/storm municipal treatment plant in Providence, Rhode Island. With its relatively low construction and maintenance cost, the detention pond appears to be an economical way to treat urban runoff. (Rochester-PTT)
W86-04363

VARIANCE ANALYSES AND CRITERIA FOR TREATMENT REGULATIONS,
Montana State Univ., Bozeman. Dept. of Civil Engineering and Engineering Mechanics.
A. Amirtharajah.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 34-49, March 1986. 6 fig, 11 tab, 55 ref.

Descriptors: *Waterborne disease, *Treatment regulations, *Filtration, *Disinfection, *Reservoir storage, *Performance evaluation, Giardia, Viruses, Diseases.

In order to develop the methodology for analyzing variances from required treatment regulations, the performance capabilities of filtration, disinfection, and reservoir storage are reviewed. Particular attention is focused on the removal and inactivation efficiences for Giardia and viruses. The three variance analyses described here are based on estimating the percent of removal and inactivation of the target organisms in a particular system compared to standard treatment methods. For illustration, the methodology was applied in three cases. Factors influencing eligibility for variances include long contact times after chlorination, dual disinfection points with redundancy, and storage of raw water for long periods. A critical feature of disinfection for variance is to operate under cysticidal ranges for Giardia, but higher chlorine doses for larger contact time values musat be constrained because of the possibility of exceeding the maximum contaminant limit for trihalomethanes. The same general principles can be applied to determine variances for groundwater systems, but inadequacies in modeling the transport of viruses in groundwater limit the semi-quantitative analysis. (Rochester-PTT)
W86-04369

BIOLOGICAL TREATMENT OF A LANDFILL LEACHATE IN SEQUENCING BATCH REACTORS,
Occidental Chemical Corp., Grand Island, NY.
W.-C. Ying, R. R. Bonk, V. J. Lloyd, and S. A. Sojka.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 41-50, February 1986. 4 fig, 12 tab, 32 ref.

Descriptors: *Leachates, *Chemical wastes, *Sequencing batch reactors, *Activated carbon, *Organic loading, *Suspended solids, *Aeration, *Mixing, *Temperature, *Process control, *Bacteria, Economics, Wastewater facilities, Pilot plants, New York.

Approximately 73,000 metric tons of chemical waste are contained in the Hyde Park, New York, landfill site. Leachate is collected, trucked to a nearby chemical manufacturing plant, and then treated with plant wastewaters by activated carbon adsorption. The leachate, which accounts for about 60% of the combined wastewater volume, but more than 80% of the total organic loading to the existing adsorption system, was found to be biodegradable easily. Excellent treatment of leachate and the combined wastewater was consistently accomplished in sequencing batch reactors SBRs), which were operated under a variety of operating conditions: wastewater total organic carbon, feed rate, variations of aeration and mixing strategies, hydraulic retention time, mixed liquor suspended solids concentration, organic loading, temperature, and cycle time. The SBR treatment performance was unaffected when wastewater feeding was suspended during weekends and holidays. Results obtained in the small bench-scale SBRs were reproduced in the pilot-scale units. An analysis of process economics indicated that significant cost saving was possible in meeting the future wastewater treatment requirements, if SBR biotreatment is implemented before the carbon adsorption. The integrated wastewater treatment system would produce a better quality effluent at a lower overall cost. Biodegradation rates for some of the more persistent wastewater constituents were enhanced in SBRs that were supplemented with strains of bacteria from the landfill site. (Rochester-PTT)
W86-04385

ALTERNATIVE RBC DESIGN--SECOND ORDER KINETICS,
Environmental Protection Agency, Cincinnati, OH. Office of Research and Development.
E. J. Opatken.
Environmental Progress ENVPDI, Vol. 5, No. 1, p 51-56, February 1986. 3 tab, 5 ref.

Descriptors: *Rotating biological contactor, *Mathematical models, *Biochemical oxygen demand, *Oxygen, *Sanitary engineering, Wastewater facilities, Bacterial physiology.

An alternative design employing second-order kinetics and good engineering practice was used to specify a rotating biological contractor (RBC) process for secondary municipal wastewater treatment. The kinetics of the RBC process had been shown to follow a second-order rate expression when the dissapearance of soluble biochemical oxygen demand (sBOD) was correlated with time. This relationship was combined with other RBC process limmitations to design an RBC system based on achieving final effluent sBOD requirements of less than 10 mg/liter. This alternative design approach can be used to determine the following: number of shafts, number of stages, shafts in each stage, sBOD in each stage, the effect on performance of diurnal fluctuations in flow from 50 to 200 percent of design flow, and when oxygen transfer. governs the kinetics. This paper demonstrates the design of an RBC plant by the second-order kinetics method and compares this with the procedure in the Atotrol Wastewater Treatment Systems Design Manual. (Rochester-PTT)
W86-04396

RESIDUAL CADMIUM FORMS IN ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-04414

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: I. A CASE STUDY,
Guelph Univ. (Ontario). Dept. of Soil Science.
For primary bibliographic entry see Field 5B.
W86-04417

SELF-SEALING OF EARTHEN LIQUID MANURE STORAGE PONDS: II. RATE AND MECHANISM OF SEALING,
New Liskeard Coll. of Agricultural Technology (Ontario).
For primary bibliographic entry see Field 5B.
W86-04418

MICROBIOLOGICAL TREATMENT OF URANIUM MINE WATERS,
Kerr-McGee Corp., Oklahoma City, OK.
J. W. Kauffman, W. C. Laughlin, and R. A. Baldwin.
Environmental Science and Technology, Vol. 20, No. 3, p 243-248, March 1986. 3 fig, 4 tab, 13 ref.

Descriptors: *Wastewater treatment, *Uranium, *Mine drainage, *Microbial degradation, Mine wastes, Selenium, Uranium, Molybdenum, Sul-

fates, Clostridium, Ambrosia Lake, New Mexico, Field tests.

Percolation of uranium mine discharge water through Ambrosia Lake, NM, soil is shown to be an effective method for lowering selenium, uranium, molybdenum, and sulfate concentrations in the mine water. Selenium concentrations were lowered from approximately 1.6 to <0.05 mg/L by reduction of soluble selenate and selenite to insoluble selenium metal. This reaction is most likely performed by bacteria belonging to the genus Clostridium. In addition, sulfate-reducing bacteria in the soil, such as Desulfovibrio bacteria, metabolize sulfate to hydrogen sulfide, which reacts with uranyl and molybdate ions to form insoluble uranium and molybdenum species. During column startup, minor variations in either temperature or flow rate impacted selenium removal. However, similar variations had virtually no effect on columns that had continuously removed selenium to less than 0.050 mg/L for at least several days. Selenium removal could be affected at flow rates up to the mechanical failure of the column bed (900 L/sq m/day) provided sufficient nutrients were available. Uranium and molybdenum removals were not observed until nutrients in addition to ones present in the soils were introduced. Nutrient concentration had the greatest impact on column performance. Acceptable contaminant removal could be achieved even with major excursion of other process variables provided an adequate supply of nutrients was available. The process was successfully field tested for 7 months in a soil column 1.5 m deep. (Lantz-PTT)
W86-04438

MICROBIAL ASPECTS OF THE INUVIK SEWAGE LAGOON,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. G. Henry, and D. Prasad.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 117-128, 1986. 8 fig, 4 tab, 15 ref. Contract No. OST 84-00158.

Descriptors: *Wastewater lagoons, *Microbiological studies, *Inuvik, Northwest Territory, Arctic, Hydrogen in concentration, Solids, Suspended solids, Chemical oxygen demand, Biological oxygen demand, Wastewater treatment, Cold regions, Ice, Bacterial degradation.

A facultative sewage lagoon in Inuvik, N.W.T. was studied in August (ice free) and November (ice covered) 1984. Emphasis was placed on the microbiological aspects and their relation to lagoon performance. Analyses performed included, pH, total alkalinity, total solids, suspended solids, volatile solids, COD and BOD5 determinations. The microbiological tests included total plate counts (20 C) and psychrotrophic counts (1 C). Results indicated that the Inuvik sewage lagoon system achieved removal efficiencies, ranging from 90% BOD5 removal in summer to about 80% in winter. The total bacterial count was found to decrease in the liquid of the primary cells in the winter, but the bacterial count in the secondary cell was similar under both winter and summer conditions. No significant difference existed in bacterial counts in the sludge samples between primary and secondary cells. The total bacterial number decreased by one order of magnitude in the winter in sludges from all cells. A shift from mesophilic to psychrotrophic bacteria occurred in the winter. The percentage of psychrotrophs increased from less than 1% to over 80% with the change in season. The role of psychrotrophs in lagoon performance is discussed. (Author's abstract)
W86-04484

LAGOON TREATMENT OF MUNICIPAL SEWAGE EFFLUENT IN A SUBARCTIC REGION OF CANADA (YELLOWKNIFE, N.W.T.),
Government of the Northwest Territories, Yellowknife. Water Resources Div.
R. N. Soniassy, and R. Lemon.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 129-139, 1986. 10 fig, 2 tab, 8 ref.

Descriptors: *Wastewater lagoons, *Subarctic zone, *Yellowknife, *Northwest Territories, *Sewage effluents, Raw wastewater, Biological oxygen demand, Coliforms, Streptococci, Nickel, Zinc, Copper, Cadmium, Lead, Mercury.

The performance of a municipal sewage lagoon in a subarctic climate (Yellowknife, N.W.T.) was evaluated over a one period to determine its seasonal treatment capabilities. Raw sewage (influent) and treated effluent were analyzed for several physicochemical and microbiological parameters. Effective removals of BOD5, total coliform, fecal coliform, feca; streptococci and heavy metals (Cu, Ni, Zn, Cd, Pb and Hg) were obtained from mid-June to mid-September. No evidence of treatment was observed when the lagoon was under ice cover (October to May). The concentrations of several heavy metals (Cu, Zn and Pb) were found to decrease gradually, reaching a low in summer, before rising again in the fall and winter. A system of managing cold climate lagoons, based on ambient temperature, is presented. (Author's abstract)
W86-04485

CONCENTRATION OF IMPURITIES DURING MELTING OF SNOW MADE FROM SECONDARY SEWAGE EFFLUENT,
British Columbia Univ., Vancouver. Dept. of Geological Sciences.
R. Zapf-Gilje, S. O. Russell, and D. S. Mavinic.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 151-156, 1986. 4 fig, 6 ref.

Descriptors: *Artificial snow, *Effluents, *Wastewater, *Nutrient removal, Cold regions, Freeze-thaw tests, Infiltration, Wastewater treatment.

When snow is made from sewage effluent, the impurities become concentrated in the early melt leaving the later runoff relatively pure. This could provide a low cost method of separating nutrients from secondary sewage effluent. Laboratory experiments showed that the degree of concentration was largely independent of the number of melt freeze cycles or initial concentration of impurity in the snow. The first 20% of melt removed with it 65% of the phosphorus and 90% of the nitrogen from snow made from sewage effluent; and over 90% of potassium chloride from snow made from potassium chloride solution. Field experiments with a salt solution confirmed in the laboratory results. (Author's abstract)
W86-04487

DEVELOPMENT OF AN ON-LINE ZERO CHLORINE RESIDUAL MEASUREMENT AND CONTROL SYSTEM,
Metro Renton Treatment Plant, WA.
R. E. Finger, D. Harrington, and L. A. Paxton.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1068-1073, November 1985. 5 fig, 2 tab, 18 ref.

Descriptors: *Dechlorination, *Monitoring, *Performance evaluation, Secondary wastewater treatment, Chlorine residual analysis, Sulfonation, Residual chlorine. Seattle, Washington.

A dechlorination system was developed for removal of chlorine used for disinfection and control of biofouling prior to the discharge of chlorinated effluents. An amperometric chlorine analyzer and sulfur dioxide dechlorination were employed, with development of feed-forward and feedback controls in which measurement of chlorine residuals much greater than zero is done in order to provide a more reliable signals. This approach was tested at the Metropolitan Seattle Renton treatment plant, where two continuous chlorine residual analyzers were provided to monitor and control residual, with two levels of backup provided. The plant chlorine residual limit of less than 1.0 mg/l daily (monthly average of less than 0.5 mg/l) has been met on all but 18/1,005 days of operation so far, with the highest recorded residual being 0.067 mg/l. In all cases, the high residuals were caused by factors outside the control system. These results demonstrate that a system that measures and controls chlorine at zero concentration can be built using conventional chlorine residual analzers and simple flow proportioning equipment. The zero chlorine measurement and control system developed for the Renton treatment plant has had minimal operating problems during the first 25 months of its operation. (Rochester-PTT)
W86-04492

SMALL-DIAMETER, VARIABLE GRADE GRAVITY SEWERS,
Agricultural Research Service, Clemson, SC. Rural Housing Research Unit.
J. D. Simmons, and J. O. Newman.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1074-1077, November 1985. 4 fig, 6 ref.

Descriptors: *Septic Tanks, *Sewers, *Gravity sewers, *Domestic wastes, Wastewater lagoons, Performance evaluation, Polyvinylchloride transport lines, Design criteria.

The concept of variable-grade gravity sewers (VGS) is explained, the design, operating characteristics, and performance of a 31-house system in Mount Andrew, Alabama, are described, and recommended design criteria for VGS systems are presented. The VGS line is laid out at a relatively constant depth, regardless of grade and has a profile with many uphill and downhill sections. The outlet is lower than the inlet in any house served by the sewer. The draining process involves delays, surcharging, and many transitions from full pipe to partial pipe flow, but after the lower sections are filled, all the liquid in the inlet will reach the outlet. The Mount Andrew system consists of modified septic tanks, small-diameter polyvinylchloride transport lines and a lagoon for final treatment. After several years, the system is operating well and requires little maintenance. The septic tanks functioned without major problems, although sludge accumulated quickly because of the small sludge storage volume of the first compartment. There have been no problems with the transport lines and no tank has failed to drain because of trouble with these lines. The most important design consideration is sizing the sewer line to accomodate the required number of houses. Slope is of little concern, but the entire system still requires a net positive grade. (Rochester-PTT)
W86-04493

EFFECT OF AERATION TANK CONFIGURATION ON NITRIFICATION KINETICS,
Vysoka Skola Chemicko-Technologicka, Prague (Czechoslovakia). Inst. of Water Technology and Environmental Protection.
J. Chudoba, J. S. Cech, and P. Chudoba.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1078-1083, November 1985. 11 fig, 3 tab, 26 ref.

Descriptors: *Nitrification, *Aeration, *Activated sludge, *Respirometric measurements, *Nitride, *Hydraulics, *Flow patterns, Wastewater treatment, Mixed cultures, Bacterial physiology, Kinetics, Ammonium.

Kinetic constant of nitrification were determined by a simple respirometric method with two mixed cultures grown in hydraulically different reactors. Kinetic constants of the first stage of nitrification were considerably higher with mixed culture grown in a reactor with the plug-flow pattern than with mixed culture grown in a completely mixed (CM) reactor. Inhibition of the first stage of nitrification with mixed culture grown in the CM reactor occurred at concentrations of ammonium-N much lower than for mixed culture grown in the reactor with the plug-flow pattern. The compartmentalized system was much more suitable for nitrification than the completely mixed system. True values of kinetic constants for the second stage of nitrification cannot be determined directly by dosing nitrite into the reaction mixture because ammonia oxidation forms nitrite into the reaction mixture because ammonia oxidation forms nitrite inside the floc matrix. The constants can be computed from the data obtained during a batch exper-

iment with ammonia as a sole N substrate. (Author's abstract)
W86-04494

BACTERIOPHAGES AND FECAL BACTERIA AS INDICATORS OF CHLORINATION EFFICIENCY OF BIOLOGICALLY TREATED WASTEWATER,
Rijksinstituut voor de Volksgezondheid, Utrecht (Netherlands).
A. H. Havelaar, and T. J. Nieuwstad.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1084-1088, November 1985. 2 fig, 3 tab, 32 ref.

Descriptors: *Disinfection, *Viruses, *Fecal pollution, *Nitrification, *Chlorination, *Bioindicators, Wastewater treatment, Sulfite-reducing clostridia, Spores, Bacteriophage, Coliforms, Streptococcus.

The behavior of F specific bacteriophages was compared to that of somatic coliphages and conventional bacterial indicators of fecal pollution (thermotolerant coliforms, fecal streptococci, and spores of sulfite-reducing Clostridia). The effects of varying degrees of nitrification on reduction of bacteriophages and bacterial indicators by chlorine were compared. In general, both organic matter content and numbers of microorganisms decreased with increasing nitrification. Reduction of both F specific and somatic phages increased with increasing nitrification, whereas in all classes, F specific phages were more resistant to chlorine than somatic coliphages (up to almost one log unit in well-nitrified water). Thermotolerant coliforms were reduced by chlorination much more efficiently than bacteriophages. Resistance to reduction by chlorine was in the order: F specific bacteriophages greater than somatic coliphages greater than fecal streptococci greater than thermotolerant coliforms. Phage reduction was unrelated to chlorine residual, but correlated with chlorine dose. Highest kills were obtained in very well nitrified water, probably because of the extended life of transient free available chlorine. Chlorine does up to 5 mg/l and chlorine residuals up to 4 mg/l did not reduce spores of sulfite-reducing Clostridia. The search for disinfectant alternatives to chlorine should continue. (Rochester-PTT)
W86-04495

APPLICATION OF POLYSULFIDE FOR PRETREATMENT OF SPENT CYANIDE LIQUORS,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
J. J. Ganczarczyk, P. T. Takoaka, and D. A. Ohashi.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1089-1093, November 1985. 3 fig, 4 tab, 16 ref.

Descriptors: *Metal cyanide complexes, *Cyanide liquors, *Limesulfur, *Industrial wastewater, *Wastewater discharge, Copper, Cadmium, Nickel, Metal plating wastewater.

A simple method of treating highly concentrated cyanide liquors containing metal-cyanide complexes was developed to enable discharge of the wastewater into a municipal sewage system. Experiments consisted of: (1) treating 500 ml of Cu/Cd plating dragout wastewater with 37.1 of limesulfur; (2) treating 3000 ml of Cu/Ni plate stripper wastewater with 104 ml limesulfur; and (3) treating 300 ml of the stripper wastewater with 141 ml limesulfur. A rapid degradation of CN- occurred in all three experiments. In the first, CN- was reduced to nondetectable levels within 2 days at an initial cyanide:polysulfide ratio of 1:1.5. The residual CN- was reduced by 99.9% within 2 days in the second experiment, which was performed at the same ratio, but at a much higher initial CN-concentration. In the third experiment, which repeated the second except for a higher dosage of polysulfide-S, the heffective removal of CN- occurred within 3 days. The reaction used here effectively converted CN- to SCN- within 2-3 days at 3 C, broke down metal-cyanide complexes, and generally precipitated metals to the levels required by municipal sewer use by-laws. (Rochester-PTT)
W86-04496

CONSIDERATION OF FIRST-STAGE ORGANIC OVERLOADING IN ROTATING BIOLOGICAL CONTACTOR DESIGN,
Municipal Environmental Research Lab., Cincinnati, OH.
F. L. Evans, III.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 11, p 1094-1098, November 1985. 2 fig, 2 tab, 8 ref.

Descriptors: *Design information, *Bacteria, *Biological wastewater treatment, *Fungi, Wastewater facilities, Process control, On-site investigations, Biomass, Organic loading, Dissolved oxygen, Aerobic treatment.

Improved design procedures that have been developed from field experience are documented, including problem description, available first-stage organic overloading data for rotating biological contractors (RBCs), process design considerations, and design considerations. When the first stage of RBC operation continues with high organic loading the film thickness increases and a white-gray biomass covers substantial portions (e.g., 40%) of the media surface. Nuisance organisms, including bacterial and fungal filaments, are present, and RBC units operating under these conditions are described as organically overloaded. Design criteria to minimize overloading include: design all stages of the total plant to operate within the same maximum first-stage load limits selected, with a review of loading on a stage-by-stage basis; include operational flexibility to accomodate variable hydraulic flow paths and organic loading considerations; include the ability to vary the shaft rotational speed to enable increased operational flexibility; include dissolved oxygen (DO) measuring instrumentation and load cells in the first stage as a minimum; possibly provide a system for supplemental aeration in the first stage and subsequent stages to increase bulk fluid DO levels, improve oxygen transfer capabilities, or regulate media biomass accumulations. (Rochester-PTT)
W86-04497

OPERATION AND MAINTENANCE OF THE UOSA WATER RECLAMATION PLANT,
CH2M/Hill, Reston, VA.
M. H. Robbins, Jr., and C. G. Ehalt.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1122-1127, December 1985. 2 fig, 10 tab, 9 ref.

Descriptors: *Wastewater renovation, *Advanced wastewater treatment, *Plant operations, *Labor costs, *Electrical costs, *Chemical costs, *Nitrogen removal, *Nitrifying conditions, *Secondary treatment, Chemical treatment, Equalizing basins, Filtration, Water treatment facilities, Virginia, Granular activated carbon, Ion exchange, Plant reliability, Operating costs, Virginia.

Operational characteristics, unit process operation and maintenance (O+M) costs, and plant reliability are described for the Upper Occoquan Sewage Authority (UOSA), Virginia, advanced water treatment plant. This plant renovates wastewater for discharge to the principal water supply reservoir in Northern Virginia, and its discharge limits are among the most stringent in the United States. The plant includes a secondary treatment system, chemical treatment system, equalization basins (ballast ponds), deep-bed, multimedia pressure filters, granular activated carbon filters, and ion exchange columns (final filtration). O+M costs are tabulated for the fiscal years 1983 and 1984, including labor, electrical power, process chemicals, other utilities, supplies, contract services, insurance, administration, and equipment replacement. The impact of N removal operations on the secondary treatment system, chemical treatment system, and carbon adsorption system are described, and N removal O+M costs are provided. A lognormal analysis of plant reliability also is presented. (Rochester-PTT)
W86-04499

BIOLOGICAL TREATMENT OF CRAB PROCESSING PLANT WASTEWATER,
Maryland Univ., College Park. MEES Program.
E. L. Geiger, F. W. Wheaton, R. B. Brinsfield, and J. E. Alleman.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1128-1133, December 1985. 3 fig, 6 tab, 10 ref.

Descriptors: *Food-processing wastes, *Biological wastewater treatment, *Dissolved solids, *Extended aeration, *Biological oxygen demand, *Chemical oxygen demand, Total suspended solids, Wastewater treatment facilities, Mixed liquor suspended solids, Aeration, Biomass.

A laboratory model wastewater treatment system was operated to: (1) characterize blue crab processing plant wastewater; (2) determine a treatment scheme to produce effluent in compliance with 'best conventional pollution control technology' guidelines; and (3) reduce the dissolved organics in the effluent. Blue crab processing wastewater contains high concentrations of dissolved organics and consistently has a pH between 7.8 and 8.0. Suspended solids did not settle out on prolonged quiescent conditions, probably because of their size and density characteristics. Biological treatment using extended aeration effectively reduced the dissolved organics in crab plant wastewater, provided that a high level of biological mass was present (3,000 to 7,000 mg/l mixed liquor suspended solids) in the reactor and settling of the biolgoical mass was performed prior to effluent discharge. If dissolved organics were not removed because of insufficient retention time, settling the bacterial mass in the biological reactor for more than one hour frequently caused inversion of the mass from gas bubble formation. A retention time of 16-24 hr in the biological reactor removed approximately 90% of dissolved organics. Intermittent addition of organics followed by a 24-hr retention time after the first addition decreased BOD sub 5 and total suspended solids (TSS) significantly compared with batch treatment. The concentration of BOD sub 5, COD, and TSS in the effluent of the biological reactor with moderate organic loading was lower than from the reactor with high organic loading. (Rochester-PTT)
W86-04500

EFFECTS OF ENGINEERING CONTROLS ON METHANE FERMENTATION TOXICITY RESPONSE,
J. Yang, and R. E. Speece.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1134-1141, December 1985. 11 fig, 3 tab, 10 refs.

Descriptors: *Anaerobic digestion, *Cyanide, *Toxins, *Methane bacteria, Serum bottle technique, Biomass, Temperature, Solids retention time.

The effects of toxicity on methane fermentation were investigated using methanogenic cultures enriched on acetate as the sole carbon source and cyanide as a model toxicant. The serum bottle technique was employed, using semi-batch or semi-continuous mode. The severity and duration of methane fermentation inhibition by a slug dose of cynaide was proportional to the toxicant concentration. The continuously-stirred tank reactor with the longest solids retention time (SRT) could recover from the highest dose of cyanide, and the system with the lowest SRT recovered from the lowest slug dose. A 25-day SRT culture recovered faster than a 50-day SRT culture at 2.5 and 5 mg/l of cyanide. Recovery from cyanide inhibition was inversely related to biomass concentration. Methane fermentation inhibition was related directly to the exposure period of biomass with cyanide, and toxicity reversal was demonstrated when biomass was separated from the supernatant fluid containing cyanide. Inhibition of methane fermentation by cyanide depended on cell age. The inhibition of methane fermentation was related to the cyanide administration pattern, with the severity of inhibition increasing in the following order: buildup, washout, and constant. Reduced temperature (25 C) significantly delayed recovery of gas production from slug doses of cyanide when compared to a warmer incubation temperature (35 C). (Rochester-PTT)

W86-04501

EVALUATION OF FINE-BUBBLE ALPHA FACTORS IN NEAR FULL-SCALE EQUIPMENT,
California Univ., Los Angeles. Dept. of Civil Engineering.
H. J. Hwang, and M. K. Stenstrom.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1142-1151, December 1985. 16 fig, 2 tab, 46 ref.

Descriptors: *Sanitary engineering, *Activated sludge process, *Aeration, *Fine-bubble diffusers, Wastewater treatment facilities, Microbial oxygen uptake, Mixed liquor, Surfactants, Volumetric mass, Transfer coefficient, Mathematical models.

A practical method of measuring alpha factors for fine-bubble diffusers under rapidly changing conditions of water quality is discussed. An experimental method and mathematical models that can handle rapidly changing water quality under process conditions have been developed, along with suitable methods for parameter estimation. The models were verified experimentally with tap water containing surfactants and activated sludge mixed liquor. The pilot-scale aeration column with full-scale liquid depth under operating conditions could be used to simulate the full-scale aeration tank. The variation of alpha factor in the mixed liquor can be explained by a rapidly measured variable, microbial oxygen uptake rate (OUR). The alpha factor in detergent water for fine-bubble diffusers varied between 0.35 and 0.8, with the same concentration of surfactant. Microbial OUR in mixed liquor explained the variation of volumetric oxygen mass transfer coefficient in mixed liquor. As the water was treated, soluble substrate was removed and microbial OUR decreased to the value of endogenous phase, and the volumetric oxygen mass transfer coefficient increased. Alpha factors in mixed liquor increased significantly with increasing treatment. Alpha factors in tap water containing surfactant and mixed liquor decreased with increasing air flow rate. Alpha factors in mixed liquor decreased with increasing liquid depth. The volumetric mass transfer coefficient was linearly dependent on air flow rate in this study, a result which may be attributed to the height of the diffuser above the tank floor. (Rochester-PTT)
W86-04502

GROWTH PHYSIOLOGY OF THE FILAMENTOUS ORGANISM TYPE 021N AND ITS SIGNIFICANCE IN ACTIVATED SLUDGE BULKING,
California Univ., Berkeley. Sanitary Engineering Research Lab.
M. G. Richard, G. P. Shimizu, and D. Jenkins.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1152-1162, December 1985. 13 fig, 3 tab, 35 ref. NSF Water Resources and Engineering Program Grant CME-7918919.

Descriptors: *Bulking sludge, *Activated sludge process, *Process research, *Pseudomonas, *Bacterial physiology, *Ammonium, Wastewater treatment, Nutrient requirements, Reduced inorganic sulfur compounds, Lactate, Glucose, Low molecular weight organic acids, Leucothrix, Thiothrix.

Fourteen Type 021N isolates were obtained in axenic culture from bulking activated sludge samples and were characterized. Two closely-related organisms were represented among the isolates. One was classified tentatively in Leucothrix and the other (representing most of the isolates) was closely related to the genera Leucothrix and Thiothrix. The Type 021N isolated had a high affinity for glucose and lactate. They readily used low molecular weight organic acids as substrates for heterotrophic growth and grew mixotrophically on reduced inorganic S compounds. They seemed to possess a higher affinity for ammonium than did a representative floc-former, Pseudomonas sp. Type 021N, unlike the floc-former, had the ability, at N limitation, for unbalanced rapid assimilation and storage of ammonium. Low ammonium concentration per se did not seem to favor significantly Type 021N over the floc-former. When ammonium was fed intermittently rather than continuously, Type 021N successfully competed with the floc-former in dual-species chemostat studies at ammonium limitation, a capability which may provide it with a competitive advantage in N-limited activated sludge systems where the temporal BOD sub 5:N ratio varies signficantly. (Rochester-PTT)
W86-04503

BIOLOGICAL TREATMENT OF HAZARDOUS WASTE IN SEQUENCING BATCH REACTORS,
CECOS International, Niagara Falls, NY.
P. A. Herzbrun, R. L. Irvine, and K. C. Malinowski.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1163-1167, December 1985. 4 fig, 6 tab, 7 ref. New York State Energy Research and Development Authority Contract.

Descriptors: *Bench-scale tests, *Fill-and-draw reactor, *Organic carbon, *Sequencing batch reactors, *Biological wastewater treatment, *Sanitary engineering, Cold weather simulation, Wastewater facilities, Wastewater treatment, Phenol augmentation experiment, Energy conservation.

Bench-scale studies of sequenching batch reactors (SBRs) for use in organic carbon removal from hazardous wastes included a cold weather simulation, a phenol augmentation experiment, and an energy conservation strategy. Nine bench-scale SBRs were operated; detention times of 1.25-10 days were studied, with acceptable results for all anticipated full-scale flows. Results with a SBR operated for 8 months at temperatures as low as 3 C were not as favorable as for an identical SBR operated at 21-25 C, but discharge limitations for total organic carbon (TOC) were maintained if the rate of temperature decrease was controlled. One reactor was operated with up to 6 hr of stirred, and unstirred, unaerated feed with favorable results. TOC degradation in a 1,900 cu m SBR averaged 76% and phenol degradation averaged 99.0% during the first month of operation, with all other data indicating proper performance. The role of organic contaminant removal has shifted from adsorption on activated carbon to degradation in the SBR. With the use of carbon for polishing purposes, a significant cost and energy savings is anticipated. (Rochester-PTT)
W86-04504

INLET DESIGN FOR RECTANGULAR SETTLING TANKS BY PHYSICAL MODELING,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 8B.
W86-04505

TREATMENT OF NUTRIENT DEFICIENT WASTEWATERS,
Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Civil Engineering.
T. A. Broderick, and J. H. Sherrard.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1178-1182, December 1985. 2 fig, 3 tab, 46 ref.

Descriptors: *Biological wastewater treatment, *Aerobic treatment, *Anaerobic digestion, *Nitrogen, *Phosphorus, *Limiting nutrients, *Industrial wastewaters, Bacterial physiology, Sludge age, Anhydrous ammonia, Calcium dihydrogen phosphate.

The question of the appropriate quantity of nutrients to add to high-rate and low-rate wastewater treatment processes is discussed. Topics include: required nutrient ratios versus sludge age for aerobic and anaerobic treatment, nutrient-deficient industrial wastes, BOD:N:P ratios for wastes, and costs of supplementary N and P (1985 data). Based on past and current practices regarding addition of N and P to nutrient-deficient wastewaters, the following conclusions are drawn: (1) the maximum amount of N and P is being added to most industrial wastewaters with little regard to minimizing their addition; (2) nutrient requirements can be lowered by altering process operating conditions. High sludge ages (low-rate treatment) result in lower waste sludge production than low sludge ages (high-rate treatment), and nutrient requirements are directly proportional to waste sludge production); (3) N and P are being added at concentratioons far in excess of the requirements for anaerobic wastewater treatment systems; and (4) to minimize chemical costs, anhydrous ammonia and calcium dihydrogen phosphate should be chosen as sources of N and P, respectively. (Rochester-PTT)
W86-04506

FEASIBILITY FOR PERFORMING A RISK ASSESSMENT ON PATHOGENS,
Environmental Protection Agency, Cincinnati, OH.
L. Fradkin, S. Lutkenhoff, J. Stara, E. Lomnitz, and B. Cornaby.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1183-1188, December 1985. 1 fig, 3 tab, 19 ref.

Descriptors: *Municipal wastewater, *Sludge, *Standard formulation, Pathogenic bacteria, Pathogenic fungi, Pathogenic viruses, Pathogenic protozoa, Pathogenic helminths, Risk assessment.

The practicality of formulating guidelines to assess the risk associated with exposure to pathogens in sludge is evaluated. The feasibility of performing a microbiological risk assessment for pathogens in municipal wastewater sludge by various disposal options was evaluated. Topics include: the mechanism of pathogen transmission, selection of representative pathogens for risk assessment study, the Universal Pathway Model for movement of pathogens, bacteria, viruses, and parasites in wastewater and sludges, uncertainties and major data gaps, and likelihood of exposure to sludge-originated pathogens. Pathogens in sludge, especially pathogenic bacteria, viruses, protozoa, helminths, and fungi, have been studied in various ways, ranging from enumeration of microorganisms before and after various treatments to epidemiological documentation of the role of aerosol pathogens in human infection and disease. Priorities can be set for which exposure situations should be recognized and examined first. Data available for microbiological risk assessment for sludge pathogens varies in quality and quantity for all parts of the process for a limited number of pathogens species. Uncertainties can be identified and rational assumptions justified to augment the evaluation. Risk assessment of pathogens in sludge is a reasonable activity to undertake at this time. Although the models can be improved, sufficient data are available that should approximate reality. (Rochester-PTT)
W86-04507

TREATMENT OF INDUSTRIAL WASTEWATERS,
DHV Consulting Engineers, Amersfoort (Netherlands).
H. Kiestra, and E. Eggers.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 5-16, 1986. 10 fig, 6 tab.

Descriptors: *Wastewater treatment, *Industrial wastewater, *Biological wastewater treatment, *Physicochemical treatment, *Biological oxygen demand, Chemical oxygen demand, Reduction, Aerobic treatment, Denitrification, ANAMET, Tannery wastes, Slaughterhouse wastes, Oil wastes, Anaerobic digestion.

A general analysis is made of the current treatment methods for industrial wastewater. Mechanical, physicochemical and biological treatment processes are discussed and the pros and contras of aerobic versus anaerobic treatment are listed, in terms of biological oxygen demand (BOD) and chemical oxygen demand (COD) reduction, energy demand, operational aspects, land use, sensitivity and sludge production. In general, anaerobic treatment is attractive in cases where wastewater with high BOD concentrations has to be treated while aerobic treatment is less sensitive and allows (de)nitrification in the same reactor. The latest developments in wastewater treatment, such as the ANAMET and the Gist-Brocades systems, are pre-

sented. Three cases of industrial wastewater treatment are elaborated, concerning effluents from a tannery, a slaughterhouse and an oil refinery. (Author's abstract)
W86-04511

TREATMENT OF OIL IN REFINERY WASTEWATER IN SOUTH EAST ASIA,
Burt Consultants Pty Ltd., Singapore.
R. A. Radevsky, and D. A. Burt.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 17-21, 1986. 2 ref.

Descriptors: *Oil refineries, *Oil wastes, *Wastewater treatment, Oil industry, Effluents, Wastewater management, Water treatment facilities, Cost analysis, Design standards.

In response to more severe pollution control regulations and from a desire to reduce pollution levels, oil industry installations are having to re-examine their effluent treatment facilities. Options for upgrading the quality of effluent discharged include: improvements in water management to decrease volumes of effluent produced in processes; modification to existing effluent treatment plant both in performance and operating procedures by the installation of new components or the replacement of individual units; and the installation of completely new effluent treatment facilities using the latest technology. In most existing plants considerable increases in efficiency can be brought about at relatively low cost by the correct application of a range of options. Where new installations are being constructed valuable lessons may be learned by examining the problems that are occurring in plants already in operation. Improvements may thus be made on existing designs. (Author's abstract)
W86-04512

EFFECTS OF WATER REUSE, RECYCLING AND RESOURCE RECOVERY ON FOOD PROCESSING WASTE TREATMENT IN THAILAND,
Siametec International Ltd., Bangkok (Thailand).
R. J. Frankel, and A. Phongsphetraratana.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 23-33, 1986. 4 fig, 3 tab, 1 ref.

Descriptors: *Water reuse, *Wastewater treatment, *Thailand, *Recycling, *Waste recovery, *Food processing wastes, Canneries, Cost analysis, Water pollution control, Anaerobic digestion, Wastewater renovation, Air flotation, Byproducts.

Two food processing industries in Thailand, namely pineapple canning and tuna/sardine canning, were studied over a 10 year period to document effects of water reuse, recycling and resource recovery (both energy and product) on waste treatment needs and actual operations. Changes in terms of water consumed, energy required, waste generated, and costs per ton of raw material processed were calculated. Lower overall annual costs resulted from all water conservation and energy recovery schemes even though stricter pollution control laws were the motivating factor behind the changes. Continuous rotary pressure cookers offer the best potential for reducing energy usage in the tuna/sardine processing industry. Potential energy recovery also exists from biogas utilization generated by anaerobic fermentation of the concentrated wastes. Assuming that cooling waters are separated out, screening of segregated wastes is practices, and air flotation is used for removal of oil/grease from the highly concentrated tuna precook wastes, the overall biological oxygen demand reductions achieved by a well-operated plant will be from the 3000-6000 mg/l range down to 20 mg/l in the effluent. By-product recovery of the screenings for animal feed production, oil/grease skimmings for soap production, together with reuse of can cooling waters, enhance the economics of wastewater treatment and reduce overall water supply/waste treatment costs. (Lantz-PTT)
W86-04513

PALM OIL PROCESSING - NEW DEVELOPMENT IN EFFLUENT TREATMENT,
Palm Oil Research Inst. of Malaysia, Kuala Lumpur.
A. N. Ma, and A. S. H. Ong.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 35-40, 1986. 7 tab, 16 ref.

Descriptors: *Palm oil processing, *Industrial wastes, *Effluents, *Wastewater treatment, Wastewater renovation, Water reuse, Recycling, Fertilizers, Biogas production, Biogas utilization, Animal load.

Since 1980, the concept of palm oil mill effluent treatment has changed, and there have been several research and development projects to investigate the utilization of the so called waste materials from the palm oil mills. A pollution prevention approach has been increasingly adopted by the industry. Anaerobic liquor is being beneficially recycled to crops and improved crop yield and soil properties have been recorded, and biogas is being harnessed for heat and electricity generation. This paper highlights some of the recent developments through: (1) biogas production and utilization, (2) land application as fertilizer, and (3) utilization of decanter solids as fertilizer or as an animal feed. (Author's abstract)
W86-04514

RUBBER BASED INDUSTRIES: A CASE STUDY ON EFFLUENT TREATMENT,
Rubber Research Inst. of Malaya, Kuala Lumpur (Malaysia).
C. K. John, and P. F. Shea.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 41-46, 1986.

Descriptors: *Rubber, *Industrial wastes, *Wastewater treatment, *Effluents, Aeration, Aerators.

In Malaysia, the bulk of natural rubber produced is exported. Only 4% is currently used by the domestic market in the production of manufactured goods. Whereas much has been written about waste treatment with respect to processing of the raw latex, little has been published on the particular difficulties of treating the waste generated during manufacture of rubber based products. Described are characteristics of the raw waste, such as pH, temperature, chemical oxygen demand, biological oxygen demand, and suspended solids. The treatment works relied to a large extent on manual control for desludging. Other control systems were generally either continuous, such as the aerators although intermittent operation was provided by timers, or automatic, such as for pH correction. Phosphorus addition was by manually adjusted metering pumps. The incoming sewers delivered to a submersible pump pit from which the waste was pumped to the distribution channel of the sedimentation tanks. Discharge was to the lagoons either parallel or in series and then the outfall. (Lantz-PTT)
W86-04515

ANIMAL FARMING EFFLUENT PROBLEMS - AN INTEGRATED APPROACH: RESOURCE RECOVERY IN LARGE SCALE PIG FARMING,
Food and Agriculture Organization of the United Nations, Singapore.
E. P. Taiganides.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 47-55, 1986. 3 fig, 3 tab, 6 ref.

Descriptors: *Farm wastes, *Effluents, *Waste recovery, *Animal wastes, Pig farming, Biodegradation, Anaerobic digestion, Sedimentation, Anaerobic lagoons, Dewatering, Filtration, Water resuse.

A waste treatment plant integrated with treated water recycle, biogas energy recovery, plus solids stabilization and reuse has been constructed in 1985 on a 20,000 standing pig population (SPP) farm. The plant incorporates biotechnologies developed under R&D Projects in the Primary Production Division (PPD) of Singapore with grants from the United Nations Development Programme (UNDP), the Australian Development Assistance Bureau (ADAB), the International Development Research Centre (IDRC) of Canada, the Food Waste Materials Utilization Project of the Association of Southeast Asian Nations (ASEAN) and the Technical assistance of the Food and Agriculture Organization (FAO) of the United Nations. The treatment processes include biogas digestion, chemically aided sedimentation, modified anaerobic lagoon, solids dewatering through sand filters and centrifuge, oxidation ditch aeration basins, etc. The aim of the Project is to determine the technical requirements and costs of producing effluents of 250 mg/l and 50 mg/l BOD integrated with resource recovery and reuse. (Author's abstract)
W86-04516

REUSE, RECYCLING AND RESOURCE RECOVERY IN INDUSTRIAL APPLICATIONS,
Camp Scott Furphy Pty Ltd., Chatswood (Australia).
I. B. Law.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 57-67, 1986. 3 fig, 3 tab, 13 ref.

Descriptors: *Recycling, *Waste reuse, *Resource recovery, *Waste recovery, Industrial wastes, Industrial wastewater, Industrial water, Effluents, Cost analysis, Economic feasibility.

Growing environmental pressures and escalating intake water costs are causing an increasing number of industrialists to reappraise their effluent treatment facilities with a view to effluent recycle and/or resource recovery. In certain instances industrialists have opted for treated sewage effluent as a water source for their process. Industries are, in some instances, practicing not only water reuse but also resource recovery, whereby valuable raw materials and/or by-products are recovered from the wastewater streams - with the value of these recovered resources often off-setting the costs associated with the more advanced degrees of treatment required. This paper covers examples of industrial applications where reuse, recycling and/or resource recovery has found application and attempts to highlight the fact that water can be saved by industry and that treatment facilities can operate profitably if the overall water handling system within the industry is carefully planned. (Lantz-PTT)
W86-04517

REDUCTION OF PULP AND PAPER INDUSTRY EFFLUENT LOADING,
Tampere Univ. of Technology (Finland).
A. Luonsi, P. Vuoriranta, and P. Hynninen.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 109-125, 1986. 12 fig, 9 tab, 20 ref.

Descriptors: *Pulp and paper industry, *Pulp wastes, *Industrial water, *Industrial wastewater, Water conservation, Bleaching wastes, Anaerobic digestion, Activated sludge, Effluent, Wastewater treatment.

The pulp and paper industry consumes large volumes of water i.e. 10-300 cu m/t of product. The most important measure in reducing the pollution charge is a reduction in water consumption. Thereafter, efficient and more easily controllable methods can be used for the treatment of lower volume, more concentrated and warmer wastewaters. Application of medium consistency techniques in production, water recirculation, and more efficient use of wood are pushing development in this direction. The present trend in pulp and paper industry production will result in more efficient use of raw materials, which in practice means increasing production of mechnical pulps. Also, the utilization of wastepaper will increase. Modified cooking and decreasing use of chlorine in final bleaching will reduce the effluent charge of harmful chlorinated organic compounds from chemical pulping. Medium consistency techniques will be increasingly applied in unit processes leading to decreased water and energy consumption. Anaerobic technology will be applied for concentrated wastewaters of (chemi)-mechanical pulp and paper production. Practical applications, of which examples have been presented in this paper, have shown their potential for economical treatment. Also, some fractions of chemical pulp production are

applicable to anaerobic treatment. For dilute mill effluents the activated sludge process is so far the most common. In order to improve the economy of the plants and to reduce eutrophication of sensitive inland waters, the nutrient balance of the process must be increasingly close. The goals of treatment have mainly been set to reduce the loading of oxygen consuming substances. In the future, economy of treatment processes, and the ability to remove specific pollutants, will be the major aspects of concern. Therefore, it is important that the specific compounds which necessarily must be removed in the future should be thoroughly studied and determined in order to guarantee proper selection of treatment methods. If one substance is removed from the wastewater stream, unless completely mineralized, it will go into the air or to the sludge, so systems must be selected which waste materials can be returned most economically to natural circulation. (Lantz-PTT)
W86-04521

TREATMENT OF WASTE WATERS FROM MALTING, BREWING AND DISTILLING,
Taylor (John) and Sons, London (England).
L. J. Smith.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 127-135, 1986. 1 fig, 1 tab, 5 ref.

Descriptors: *Industrial wastewaters, *Wastewater treatment, *Breweries, *Distilleries, Biofiltration, Biological oxygen demand, Filtration, Activated sludge, Anaerobic digestion, Fluidized beds.

The origin and nature of the malting, brewing and distilling wastewaters is briefly described. Possible methods of treatment are reviewed with passing reference to some typical examples. The effect of climate is considered. The second half of the paper is devoted to process selection, design and operation of a high rate plastics media filter treatment plant for Bass Brewing Ltd., at Runcorn U.K. with special reference to measures to avoid nuisance from the readily putrescible wastewaters and an indication of cost. Of the treatment methods of which there is experience, bio-filtration is the most worthy of recommendation. High rate versions of the process using specially designed plastics medium, apart from facilitating partial treatment at high BOD loadings, will also permit up to 95% BOD removal at loadings higher than could be applied to conventional medium filters. While high rate filters are considered preferable to activated sludge on technical grounds, there is not necessarily an energy saving when the cost of pumping to tall towers in two stages is taken into account. On grounds of energy conservation, rotating biological contactors may have the advantage, due to low head requirements, while sharing with high rate filters the merit of a captive biomass. Anaerobic treatment is theoretically attractive on energy economy and sludge yield considerations. It may be particularly appropriate where ambient temperatures approach the required process temperature. Brewery effluent may be too weak for present forms of the process. The advent of fluidized bed and other new technology designs to conserve organisms in the process, may increase the scope and success of anaerobic treatment. In the case of the pretreatment plant described, there is a cost advantage in pretreatment as compared with accepting Water Authority trade effluent charges for the whole untreated discharge, even if this were feasible. The plant provided turned out to be larger than strictly necessary for the BOD load that has in fact been produced. There does however, appear to be a slight cost advantage in treating to the higher standard. (Lantz-PTT)
W86-04522

MECHANISMS OF DYE WASTEWATER COLOUR REMOVAL BY MAGNESIUM CARBONATE-HYDRATED BASIC,
Chulalongkorn Univ., Bangkok (Thailand). Faculty of Engineering.
T. Panswad, and S. Wongchaisuwan.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 139-144, 1986. 3 fig, 1 tab, 14 ref.

Descriptors: *Wastewater treatment, *Color removal, *Dye industry wastes, Alum, Quick lime, Chemical treatment, Magnesium carbonate, Flocculation, Calcium carbonate, Calcium hydroxide, Magnesium hydroxide, Sorption.

Alum and quick lime are the common chemicals used presently as coagulants in color removal from dye wastewaters. However, these chemicals were found to be ineffective in color reduction, especially when the dyestuff was the reactive dye type. Magnesium carbonate was then suggested as a substitute coagulant in the water treatment process with reports indicating good results in color removal from textile dye wastewaters. Since high grade magnesium carbonate is not readily available, pure hydromagneaite or magnesium carbonate-hydrated basic (3MgCO3.Mg(OH)2.H2O), which hereafter shall be referred to as MCHB, was selected and investigated. The capability of alkaline MCHB in terms of color reduction from a reactive red dye wastewater was examined, and its color removal mechanisms analyzed. Other flocculants, such as CaCO3 ppt. and Ca(OH)2 solids, formed from other reactions were also investigated for comparison purposes. The raw wastewater was synthetic containing 300 mg/cu dm reactive red dye 519. It has been found that no single flocculant (Mg(OH2), Ca(OH)2 or CaCO3) can satisfactorily effect color removal. The effective color reduction achieved using alkaline magnesium carbonate-hydrated basic has been attributed to the synergistic sorbing capacity of the flocculants Mg(OH)2 and CaCO3. (Lantz-PTT)
W86-04523

OPTIMIZATION OF THE ICP WORKING CONDITIONS FOR THE ANALYSIS OF WASTE WATERS AND INDUSTRIAL SOLUTIONS,
Institute 'Niproruda', Sofia (Bulgaria).
For primary bibliographic entry see Field 5A.
W86-04548

MUNICIPAL PRETREATMENT PROGRAM GOES ON LINE,
Hubbell, Roth and Clark, Inc., Bloomfield Hills, MI.
G. E. Hubbell, R. Zietz, and W. Ewing.
Water Engineering and Management WENMD2, Vol. 133, No. 1, p 22-24, January 1986. 5 tab.

Descriptors: *Industrial waste pretreatment, *Industrial wastewater, *Data storage and retrieval, *User survey, *Monitoring, *Industrial wastewater, Funding, Michigan, Analysis, Sludge, Sludge cake, Metals, Asbestos, Phenols.

The Flint, Michigan, industrial pretreatment program is described in terms of the following aspects: master plan, user survey, discharge limitation development, evaluation of equipment needs, development of funding mechanisms, and data base management system. Information on user classification, results of testing primary sludge, secondary sludge, filter cake, and effluent for metals, asbestos, and phenols, the monitoring schedule employed, equipment requirements, and personnel requirements is presented. The Flint program involves more than 5,700 industrial and commercial businesses. Its goals are: to prevent interference with the operation of publicly owned treatment works (POTW), to prevent the introduction of toxic and incompatible pollutants into POTW that will receive inadequate treatment and will pass through harmful quantities and concentrations, and to prevent the contamination of sewage sludge and thus limit sludge management alternatives and increase operational cost of the POTW. (Rochester-PTT)
W86-04549

TWO OPTIONS FOR TREATMENT OF ACIDIC ORGANIC INDUSTRIAL WASTES,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
N. Millot, N. Dalga, and N. Foussard.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 5-17, 1986. 4 fig, 7 tab, 7 ref.

Descriptors: *Industrial wastes, *Organic wastes, *Acidic wastes, *Waste treatment, *Wet oxidation process, Organic compounds, Waste disposal, Solidification, Sludge.

The treatment of acidic, organic, industrial wastes poses many problems. These wastes are characterized by a high organic concentration and pH values approaching zero. The classic treatment processes (incineration, physicochemical treatment, solidification) are plagued by problems with corrosion, by-products formation and ultimate disposal. This paper proposes two new processes for treating these wastes. The first technique is a pressurized oxidation process at high temperature. Wet oxidation requires a major investment of about $2 million, but has the advantage of permitting very high degrees of oxidation whatever the type of organic waste to be treated. The treated effluents have low organic contents, which make it possible to envisage the application of conventional biological or physicochemical treatment before their disposal. Results show total organic carbon (TOC) removal above 96%. The second proposed technique is an improved solidification which incorporates an adsorbent into the solid to immobilize the organic content. A very thick sludge (solids about 60%) is obtained which dries very quickly. Tests on the solids indicate that any leachate formed will be much lower in strength than leachate from the classic solidification process. Landfill disposal of the solidified waste is possible under proper conditions. (Lantz-PTT)
W86-04561

HEAVY METAL REMOVAL IN THE PRESENCE OF COLLOID-STABILIZING ORGANIC MATERIAL AND COMPLEXING AGENTS,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
I. Licski, and I. Takacs.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 19-29, 1986. 14 fig, 6 ref.

Descriptors: *Heavy metals, *Colloids, *Organic compounds, *Stabilizing agents, Complexing agents, Wastewater treatment, Magnesium, Copper, Zinc, Chromium, Nickel, Cadmium, Ammonium salts, Hydrogen ion concentration, Phase separation.

It has been established in laboratory model experiments that the removal of dissolved heavy metals from wastewaters is rendered more difficult in the presence of colloid-stabilizing agents. This unfavorable effect can be eliminated by the addition of Mg(2+) ions and the adjustment to a fairly high pH. By increasing the concentration of Mg(2+) ions, the pH necessary for destroying the stability of colloidal dispersion can be lowered. These findings also apply to the combined removal of different heavy metals (Cu, Zn, Cr(III), Ni, Cd). In alkaline conditions, in the presence of ammonium salts, some heavy metals (Cu, Zn, Ni) form high stability amine complexes. A higher pH is necessary for the breakdown of these complexes and the satisfactory removal of heavy metals. (Author's abstract)
W86-04562

TREATMENT OF TAR SAND WASTEWATERS WITH ACTIVATED CARBON, OZONE AND REVERSE OSMOSIS,
Arizona Univ., Tucson. Dept. of Civil Engineering and Engineering Mechanics.
R. A. Sierka, and P. H. King.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 43-54, 1986. 2 fig, 5 tab, 20 ref.

Descriptors: *Wastewater tretment, *Activated carbon, *Ozonation, *Reverse osmosis, Tar sands, Vernal, Utah, Combustion, Ozone, Stream flooding, Total organic carbon.

Tar sand deposits offer long-term potential for satisfying future energy needs. Two large field-scale extraction experiments near Vernal, Utah, employed either a sequenced reverse-forward combustion technique (TS-2C) or a steam flooding procedure (TS-1S) to recover in-place bitumen. This report documents the evaluation of activated carbon, ozone and reverse osmosis in treating the two types of tar sand wastewaters. Substrates included untreated and pretreated (filtration, foam fractionation, chemical treatment with ferric chlo-

ride) TS-1S and TS-2C wastewaters. Activated carbon, at a dose of 1,000 mg/L, reduced the Total Organic Carbon (TOC) of TS-1S wastewater after treatment by 350 mg/L of ferric chloride to 2.3 mg/L TOC, a reduction of 91.6%. At the same adsorbent dose, activated carbon reduced the TOC in TS-2C wastewater from 678 mg/L to 546 mg/L. A study of the six commercially available adsorbents yielded little difference in adsorption capability for either wastewater. Ozonation of TS-1S wastewater after pretreatment by either foam fractionation or chemical treatment with ferric chloride then activated carbon yielded residual TOC levels of less than 1.2 mg/L. Reverse osmosis (RO) studies included investigation of four membrane types (cellulose acetate, poly-ether amide, poly-ether urea and a noncellulosic on a poly-sulfone base), three applied pressure levels (250, 400 and 550 psig) and two solution pH levels (5.5 and 7.8) with 5.0 micron filtered TS-2C wastewater as the substrate. A two-stage RO process achieved maximum organic and inorganic rejections of 98% and 97%, respectively. (Author's abstract)
W86-04564

WATER TREATMENT BY MEANS OF ACTIVATED CARBON, PREPARED FROM LOCALLY AVAILABLE WASTE MATERIALS (II),
Vrije Univ., Brussels (Belgium). Dept. of Industrial Chemistry.
H. Keirsse, F. van Hoof, J. Janssens, and A. Buekens.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 55-66, 1986. 7 fig, 4 tab, 5 ref.

Descriptors: *Activated carbon, *Wastes, Carbonization, Activation, Local wastes, Fluidized bed reactor, Adsorption, Cacao hulls, Sawdust, Fruit stones, Bark, Industrial wastewater, Thermal properties.

Man's natural water supplies are threatened by a large number of nonbiodegradable and toxic organic compounds. Proper environmental standards often can only be attained using tertiary treatment process, such as adsorption on activated carbon. The latter is an expensive process, owing to the initial cost of activated carbon and the losses occurring during regeneration. Methods are being investigated at the Free University of Brussels for producing and activating carbon, using various types of waste as a raw material. The following materials have already been used: cacao hulls, sawdust, fruit stones, bark, and waste tyres. Both carbonization and activation have been conducted under the carefully controlled conditions of a fluidized bed reactor. The influence of the following process parameters has been investigated: pyrolysis temperature and time, activation temperature and time, and composition of the furnace atmosphere. The resulting activated carbons should exhibit the following qualities: high adsorption capacity and rate, good resistance to attrition, and possibility of regenerating the carbon. The properties of the carbon obtained have been evaluated by means of a number of standard tests (Iodine-index, BET-surface, Tannin-index, Methylene blue-index, and Phenol-index), and adsorption isotherms of phenol, pentachlorophenol, p. toluene sulphonate and dodecyl benzenesulphonate. In general the properties of the carbons obtained were comparable to those of commercial qualities. Some of the activated carbons tested will soon be evaluted using synthetic and real phenolic industrial wastewaters (1.5% of phenol). (Author's abstract)
W86-04565

ELIMINATION OF MICROPOLLUTANTS BY NAALO2 FLOCCULATION DURING PRIMARY TREATMENT OF MIXED WASTEWATER,
Brussels Univ. (Belgium). Lab. de Traitement des Eaux et Pollution.
J. P. Vanderborght, and R. Wollast.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 67-74, 1986. 6 fig, 5 tab, 4 ref.

Descriptors: *Micropollutants, *Sodium aluminate, *Primary wastewater treatment, Wastewater treatment, Flocculation, Suspended solids, Organic matter, Chemical oxygen demand, Heavy metals, Zinc, Cadmium, Copper, Chromium, Nickel, Phosphates.

Sodium aluminate, a well-known flocculating agent occasionally used in the water supply industry, has never veen in serious competition with other chemicals such as aluminum sulfate or ferric chloride for the physicochemical treatment of wastewater. The development of a new method for the treatment of wastewater from aluminum anodization plants, in addition to successful disposal of the spent liquors of this major industrial activity, could lead to a large production of concentrated NaAlO2 solution under attractive economical conditions, and turn sodium aluminate into a valuable alternative to more classical flocculating agents. To evaluate the performance of NaAlO2 flocculation in the primary treatment of domestic wastewater has been purpose of this two-year laboratory and field study. It was demonstrated that, for suspended solids (S.S.) concentrations in the range of 200 - 350 mg/l, flocculation with sodium aluminate at concentrations ranging from 30 to 100 mg AlO2/l could increase the S.S. removal from a typical value of 40% without floccuation to those as high as 70%. For organic matter, a 40% removal of the total COD was reached (75% of the particulate COD), as compared with a 20% removal in the primary treatment without flocculation. Phosphate removal was always greater than 90%, with residual PO4(3-) concentrations below 1 mg P/l. In comparison with the primary sedimentation, aluminate addition results in a lower residual concentration for Zn and Cd. For all metals under investigation (Cu, Cr, Zn, Cd, and Ni), the removal was found to be irreversivle. Biological treatment was uninhibited by an addition of these metals when NaAlO2 - flocculation was provided. (Lantz-PTT)
W86-04566

UPGRADING OF A WASTEWATER TREATMENT PLANT IN A CHEMICAL FACTORY,
Vizgazdalkodasi Tudomanyos Kutato Intezet, Budapest (Hungary).
P. Benedek, I. Takacs, and I. Vallai.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 75-82, 1986. 2 fig, 2 tab, 13 ref.

Descriptors: *Wastewater facilities, *Chemical wastewater, *Chemical industry, Industrial wastewater, Micropollutants, Organic compounds, Organic loading, Powdered activated carbon, Biodegradation, Sludge, Foaming.

Full-scale experiments were conducted to study the wastewater treatment plant of a chemical factory. The objective of the study was to upgrade the overloaded biological activated sludge system by powdered activated carbon addition. Improvement of the organic micropollutant removal characteristics was also expected on the basis of previous experiments. Despite the sometimes unfavorable conditions, (e.g. lack of oxygen), 30-40% improvement in performance could be achieved on the powdered activated carbon (PAC), biological treatment plant compared to the control unit. Discharging equal effluent quality, the PAC unit could be overloaded by 20% without any decrease in efficiency. The optimal PAC dose was relatively low, less than 100 g/cu m despite the high organic content of the influent (COD = 3000 g/cu m). Applying PAC dosage would lead to a 20-30% increase in operational costs. Foaming and sludge were no longer a problem, and the sludge volume index decreased to 20 l/kg. An important result of the process is a 20-50% decrease in the concentration of micropollutants compared to that of the control unit. The inclusion of PAC dosage in the treatment line would therefore contribute to the improvement of the receiving waters. (Lantz-PTT)
W86-04567

ALGAE REACTIONS TO MINERAL AND ORGANIC MICROPOLLUTANTS, ECOLOGICAL CONSEQUENCES AND POSSIBILITIES FOR INDUSTRIAL-SCALE APPLICATION: A REVIEW (REVUE DES REACTIONS DES ALGUES AUX MICROPOLLUTANTS MINERAUX ET ORGANIQUES; CONSEQUENCES ECOLOGIQUES ET POSSIBILITIES D'APPLICATIONS INDUSTRIELLES),
Societe Degremont, Rueil-Malmaison (France).
For primary bibliographic entry see Field 5C.
W86-04568

DISSOLVED AIR FLOTATION FOR ABATTOIR WASTEWATER,
Commonwealth Scientific and Industrial Research Organization, North Ryde (Australia). Div. of Food Research.
D. A. Lovett, and S. M. Travers.
Water Research WATRAG, Vol. 20, No. 4, p 421-426, April 1986. 8 fig, 16 ref.

Descriptors: *Industrial wastewater, *Dissolved air flotation, Flotation, Wastewater treatment, Suspended solids, Chemical oxygen demand, Saturator pressure, Fat, Removal efficiency.

The performance of laboratory-scale dissolved air flotation plants treating abattoir wastewater has been measured for saturator pressures from 100 to 550 kPa, wastewater suspended solids concentrations from 170 to 2100 mg/l and air-to-solids ratios from 0 to 0.17. Maximum removal efficiencies for chemical oxygen demand, suspended solids and fat wre 70, 50, and 95% respectively, at high wastewater suspended solids contents and high air-to-solids ratios. Pressure did not greatly influence the size of the bubbles generated in the process, or the removal efficiencies. High air-to-solids ratios were necessary to obtain maximum removal efficiencies and to prevent appreciable settling of the suspended solids. (Author's abstract)
W86-04570

DYNAMIC MODELLING OF ANAEROBIC DIGESTION,
Institut National de la Recherche Agronomique, Massy (France). Station de Technologie Alimentaire.
R. Moletta, D. Verrier, and G. Albagnac.
Water Research WATRAG, Vol. 20, No. 4, p 427-434, April 1986. 9 fig, 3 tab, 15 ref.

Descriptors: *Dynamic modeling, *Anaerobic digestion, *Mathematical models, Model studies, Wastewater treatment, Bacteria, Biomass, Metabolites, Methane bacteria, Acid bacteria, Carbon dioxide.

The anaerobic digestion model presented here considers a two step process. First, acidogenic bacteria convert glucose into acetate then methanogenic bacteria convert this acid into methane and carbon dioxide. The biomass and metabolite production rates are described by distinct mathematical relationships. Therefore, there is not a direct relationship between the growth and the energy production related to metabolite formation. The inhibitory effects of the unionized acid concentration on growth rate of both bacterial populations and the methane production from acetate were considered separately. The model was tested in batch cultures with two types of organic loads, i.e. pea bleaching wastewaters and a synthetic substrate containing sucrose and organic acid. The model simulated satisfactorily the methane production under very different operational conditions. (Author's abstract)
W86-04571

EXTERNAL MASS TRANSFER DURING THE ADSORPTION OF VARIOUS POLLUTANTS ONTO ACTIVATED CARBON,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
G. McKay, M. J. Bino, and A. Altememi.
Water Research WATRAG, Vol. 20, No. 4, p 435-442, April 1986. 10 fig, 8 tab, 7 ref.

Descriptors: *Mass transfer, *Activated carbon, *Water treatment, *Water pollution treatment, Phenols, Adsorption, Model studies, Mathematical studies, Sherwood number, Schmidt number, Mercury, Sodium dodecylate.

A wide range of experimental studies are reported for the adsorption of phenol and p-chlorophenol onto activated carbon - Type Filtrasorb 400 - in an

agitated batch adsorber. A model has been used to determine the external mass transfer coefficient for the systems and the effect of several experimental variables have been investigated. These include agitation, initial pollutant concentration, carbon mass, carbon particle size and solution temperature. The mass transfer coefficient has been correlated in terms of the dimensionless Sh/Sc(0.33) against each variable. The Sherwood number, Sh=k sub f R/D sub mol, relates the external mass transfer coefficient k sub f to particle radius, R, and molecular diffusivity, D sub mol. The Schmidt number, Sc, is the ratio of kinematic viscosity, v, to molecular diffusivity. Results indicate that overtime, the uptake for the adsorption of SDS (sodium dodecyl sulfate) and p-chlorophenol onto activated carbon, levels off rapidly after about 1-hr of contact. In addition, when the external mass transfer coefficient (k sub f, which depends on the driving force/unit area), increasing the mass of carbon increases the surface area for adsorption, thereby increasing the rate of pollutant removal. (Lantz-PTT)
W86-04572

COMBINED USE OF CALCIUM SALTS AND POLYMERIC ALUMINIUM HYDROXIDE FOR DEFLUORIDATION OF WASTE WATERS,
Geneva Univ. (Switzerland). Dept. of Inorganic, Analytical and Applied Chemistry.
N. Parthasarathy, J. Buffle, and W. Haerdi.
Water Research WATRAG, Vol. 20, No. 4, p 443-448, April 1986. 4 fig, 7 tab, 19 ref.

Descriptors: *Calcium fluoride, *Calcium, *Polymeric aluminum hydroxide, *Defluoridation, Industrial wastewaters, Fluorides, Kinetics.

The combined use of calcium salt and polymeric aluminum hydroxide (P) for treatment of fluoridated wastewater has been described. In the proposed method of treatment the calcium ions act as the precipitant and polymeric aluminum hydroxide as the coagulant. At low fluoride concentrations (0.002 M) the precipitation reaction of calcium fluoride is a slow process. The residual fluoride concentrations found experimentally approached the theoretically predicted values only at high calcium concentrations (F sub t/ Ca sub t molar ratio=0.24) and for long equilibrium times. The addition of calcium fluoride seeds (approx. 20 mg/l) accelerated the precipitation process and the results obtained for the residual fluoride concentrations were close to the theoretically calculated ones regardless of the calcium ion concentration used. Under these conditions fine CaF2 precipitate with poor settleability was formed. The addition of small amounts of polymeric aluminum hydroxide, P, (F/Al molar ratio=10) greatly facilitates the settleability of the precipitate. The advantage of using P over alum for the removal of fluoride is that less concentration of the former is required and the reproducibility of the results are good. The effect of sulphate on the precipitation of calcium fluoride has been also studied. Tests with fluoride containing wastewater collected from aluminum industry showed that fluoride can be effectively removed. (Author's abstract)
W86-04573

ENHANCEMENT OF MERCURY (II) SORPTION FROM WATER BY COAL THROUGH CHEMICAL PRETREATMENT,
Sri Venkateswara Univ., Tirupati (India). Dept. of Civil Engineering.
J. Karthikeyan, and M. Chaudhuri.
Water Research WATRAG, Vol. 20, No. 4, p 449-452, April 1986. 4 fig, 12 ref.

Descriptors: *Mercury, *Sorption, *Chemical pretreatment, *Coal, *Pretreatment of water, Industrial wastewater, Wastewater treatment, Wastewater purification, Heavy metals, Oxidation, Nitric acid, Hydrogen peroxide, Sulfurization, Manganese oxide, Municipal wastewater.

Utilization and exploitation of mercury and mercury-based technology coupled with inadequate disposal of mercury laden waste pose an increasing threat of environmental contamination. Addition of mercury through waste discharges into natural bodies of water is of serious concern today because of probable entry of mercury into the food chain apart from possible direct ingestion. Consequently, removal of mercury from water and wastewater assumes importance. High capital and regeneration costs of active carbon and ion-exchage resins have resulted in a search for suitable alternative sorbents and to this end bituminous coal was investigated as a sorbent for removing mercury from water. A limited study has indicated the potential of coal surface modification through chemical pretreatment in enhancing mercury sorption. This communication reports the results of a detailed study on enhancement of mercury(II) sorption from water by bituminous coal through chemical pretreatment, explored in the laboratory using batch sorption tests and downflow column studies. Both intensity of sorption and equilibrium sorptive capacity were enhanced significantly following nitric acid and hydrogen peroxide oxidation. Sulfurization and manganese oxide impregnation also showed promise. The chemically pretreated coal sorbents exhibited mercury sorption to a level higher than that accomplished using active carbon. Nitric acid or hydrogen peroxide oxidized or sulfurized coal may well replace active carbon in polishing mercury laden waste following sulfide precipitation or removing mercury during municipal water treatment. This study is of significance in terms of mercury pollution control in the developing countries where imported active carbon or ion-exchange resins are very expensive. (Lantz-PTT)
W86-04574

EFFECTS OF TEMPERATURE SHOCK TREATMENTS ON THE STABILITY OF ANAEROBIC DIGESTERS OPERATED ON SEPARATED CATTLE SLURRY,
Polytechnic of Wales, Pontypridd. Dept. of Science.
M. W. Peck, J. M. Skilton, F. R. Hawkes, and D. L. Hawkes.
Water Research WATRAG, Vol. 20, No. 1, p 453-461, April 1986. 9 fig, 1 tab, 29 ref.

Descriptors: *Temperature effects, *Anaerobic digestion, *Farm wastes, *Cattle, *Slurries, Volatile fatty acids, Digesters, Anaerobic bacteria, Methanogenic bacteria.

Using laboratory scale daily fed digesters operating at steady-state on separated cattle slurry, the temperature was lowered in a similar manner to that which might be expected on a farm due to heating failure; three different recovery methods were then tested. Raising the operating temperature from 3-6 C to 35 C in a single day had only a transient effect on digester stability. Steady-state conditions were reestablished within 8 days of the temperature rise when a 25-day retention time was employed and within 6 days at 10-day retention time. However, slowly raising the operating temperature (over several days) had a more deleterious effect on digester stability. When a 25-day retention time was employed, 10 days were required from the initial temperature rise before steady-state conditions were reestablished, while at a 10-day retention time the period was greater than 12 days. It is therefore proposed that the digester temperature should be raised back up to the normal operating temperature as soon as possible after a heating failure. Digesters which were not fed during the recovery period showed a rapid removal of potentially toxic volatile fatty acids, and this procedure is recommended in the period following temperature shock. The main indicator of digester instability was a dramatic but unequal rise in the concentration of the individual volatile fatty acids. An order of sensitivity to the temperature shock treatment was established: i-butyrate - i-valerate - i-caproate > proprionate > n-valerate - n-caproate > acetate - n-butyrate. Those to the left accumulated most rapidly in the temperature stressed digester, and were removed least quickly during the recovery period. The bacteria responsible for the breakdown of the higher volatile fatty acids (presumably the obligate proton-reducing bacteria) were more sensitive to the shock treatment applied than those catabolizing acetate (presumably the acetate-utilizing methanogenic bacteria). The concentration of the branched volatile fatty acids and propionic acid were the most sensitive to the temperature shock treatment, and therefore represent more sensitive monitors of digester stability than acetic acid or the total volatile fatty acid concentration. (Author's abstract)
W86-04575

BIODEGRADATION PATHWAY OF O-CRESOL BY HETEROGENEOUS CULTURE: PHENOL ACCLIMATED ACTIVATED SLUDGE,
National Research Inst. for Pollution and Resources, Yatabe (Japan).
S. Masunaga, Y. Urushigawa, and Y. Yonezawa.
Water Research WATRAG, Vol. 20, No. 4, p 477-484, April 1986. 10 fig, 1 tab, 21 ref.

Descriptors: *Biodegradation, *Orthocresol, *Heterogeneous cultures, *Phenols, *Activated sludge, Gas chromatography, Mass spectrometry, Dihydroxytoluenes, Pathways, Cresol.

The biodegradation process of 0-cresol by heterogeneous culture is presented in this paper. Metabolic intermediates of o-cresol by phenol acclimated activated sludge were analyzed by GC-MS. o-Cresol was first transformed to three dihydroxytoluenes; 3-methylcatechol, r-methylresorcinol and methylhydroquinone. Three dihydroxytoluene biodegradation experiments with 3-methylcatechol, 4-methylresorcinol and methylhydroquinone revealed that 3-methylcatechol was the main route, and 3-methylcatechol was further degraded through at least two meta cleavage pathways. Various hydroxylated toluenes, namely trihydroxytoluenes and tetrahydroxytoluene were also found among the metabolites from 3-methylcatechol, 4-methylresorcinol and methylhydroquinone. These results indicated that various metabolism with main and side pathways coexisted in the biodegradation process by the heterogeneous culture. (Author's abstract)
W86-04578

INHIBITION OF THE ACTIVITIES OF BETA-GALACTOSIDASE AND DEHYDROGENASES OF ACTIVATED SLUDGE BY HEAVY METALS,
Yamanashi Univ., Kofu (Japan).
K. Katayama-Hirayama.
Water Research WATRAG, Vol. 20, No. 4, p 491-494, April 1986. 6 fig, 2 tab, 15 ref. Ministry of Science, Culture and Education Grant No. 575458.

Descriptors: *Beta-galactosidase, *Dehydrogenases, *Activated sludge, *Heavy metals, *Inhibition, Cadmium, Mercury, Mixed liquor suspended solids, Mercaptides, Kinetics.

Heavy metal inhibitions of the activities of beta-galactosidase and dehydrogenases in activated sludge were studied. The activities of beta-galactosidase and dehydrogenases were strongly inhibited by Cd and Hg. To produce 50% inhibition of beta-galactosidase by Cd and Hg required 1.3 and 0.0004 mmol/g mixed liquor suspended solids (MLSS), respectively. In the case of dehydrogenases, 50% inhibition appeared by Ac 0.16 and Hg 0.04 mmol/g MLSS, respectively. The inhibitions of the activities of beta-galactosidase and dehydrogenases with Cd and Hg were easily recovered with the addition of thiol compounds. Reactivation by thiols suggested that Cd and Hg form reversible mercaptides with SH groups of beta-galactosidase and dehydrogenases. The inhibitions of the activities of beta-galactosidase and dehydrogenases by Cd and Hg gave reversible non-competitive type of kinetics. The inhibitor constant (K sub i) values of beta-galatosidase for Cd and Hg were calculated to be 1.6 mM (1.7 mmol/g MLSS) and 0.005 mM (0.005 mmol/g MLSS), respectively. K sub i values of dehydrogenases for Cd and Hg were 0.06 mM(0.3 mmol/g MLSS) and 0.02 mM (0.01 mmol/g MLSS), respectively. (Author's abstract)
W86-04580

SEPARATION OF THE PROPIONATE DEGRADATION TO IMPROVE THE EFFICIENCY

OF THERMOPHILIC ANAEROBIC TREATMENT OF ACIDIFIED WASTEWATERS,
Agricultural Univ., Wageningen (Netherlands). Dept. of Water Pollution Control.
W. M. Wiegant, M. Hennink, and G. Lettinga.
Water Research WATRAG, Vol. 20, No. 4, p517-524, April 1986. 8 fig, 3 tab, ref.

Descriptors: *Propionate, *Biological degradation, *Anaerobic digestion, *Acidic water, Thermophilic bacteria, Wastewater treatment, Chemical degradation, Sludge.

In High-rate anaerobic treatment systems propionate usually is the first compound of which the breakdown deteriorates. Apparently the degradation of proprionate is very delicate. In its complete degradation, three bacteria are involved, of which the first converts propionate into acetate, hydrogen and carbonate. The other two are methanogens, converting acetate and carbonate plus hydrogen to methane. Specimens of all three bacterial groups, relevant for mesophilic high rate systems with a high biomass retention, have been isolated and described. In this paper the propionate degradation in thermophilic systems is studied. A two-stage process is developed, in which the propionate degradation is spatially separated from other conversion in which hydrogen is involved. Significantly better results were obtained with the two-stage system as compared with a one-stage system with an equal total volume: loading rates of 20-50 COD/cu m/day showed a 10-13% better treatment efficiency in the two-stage system. It is concluded that the removal of the biogas evolved in the first degradation processes is the cause of the superior performance of the two-stage system. (Lantz-PTT)
W86-04584

ECOLOGY OF SCUM CAUSING ACTINOMYCETES IN SEWAGE TREATMENT PLANTS,
Bayerisches Landesamt fuer Wasserwirtschaft, Munich (Germany, F.R.).
H. Lemmer.
Water Research WATRAG, Vol. 20, No. 4, p 531-535, April 1986. 1 fig, 34 ref. Grant No. PO 231/1-1,2.

Descriptors: *Scum, *Actinomycetes, *Wastewater treatment, Biomass, Activated sludge, Aeration, Microzones, Hydrophobes, Sludge, Flocculation.

Activated sludge scumming, a severe separation problem in sewage treatment plants, is caused in most cases by a high biomass of nocardioform actinomycetes. The aeration tank as a biotope is characterized by low average nutrient concentrations with nutrient-enriched microzones. Possible mechanisms for enrichment are discussed. Actinomycetes need high nutrient concentrations and therefore have to compete for the enriched microzones. The strategies they use encompass the ability to live saprophytically on dead cells, to use refractory organic compounds adsorbed to the sludge floc which are only slowly degraded by other organisms and the adherence to air-water and oil-water interfaces caused by the hydrophobicity of their cell wall. Adherence of air bubbles in the hyphae net causes buoyancy by which the sludge scums. Actinomycetes as former soil inhabitants are better adapted than their competitors to the conditions of dryness and ultraviolet radiation prevailing in this scum fraction. (Author's abstract)
W86-04586

KINETICS OF METHANOGENS IN AN EXPANDED-BED REACTOR,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5F.
W86-04587

FLOCCULANT SETTLING DYNAMICS UNDER CONSTANT LOAD,
Tennessee Eastman Co., Kingsport.
B. F. Severin, and R. A. Poduska.
Journal of Environmental Engineering JOEEDU, Vol. 112, No. 1, p 171-184, February 1986. 9 fig, 3 tab, 12 ref, append.

Descriptors: *Flocculation, *Clarification, Clarifiers, Settleable solids, Sludge, Chemical coagulation, Wastewater treatment, Activated sludge process, Dynamics, Model studies, Load distribution.

A model for predicting the rate of rise or fall of a sludge blanket in an overloaded or underloaded condition is developed from the steady state solids flux theory of clarification. This rate of failure model was verified with substantiating data from a laboratory-scale clarifier with ferric hydroxide floc. The model allows for more rapid assessment of flux balances than previously possible. Once a value of the empirical settling parameter is measured, calculation of the dimensionless loading parameter and underflow parameter is all that is needed to predict blanket stability and blanket dynamics. The model can be used as a functional on-line tool for clarifier control, and may be extended to cover utility for full-scale clarifiers in the activated sludge process. (Geiger-PTT)
W86-04588

LEAST-COST ACTIVATED SLUDGE DESIGN USING A MICROCOMPUTER,
National Univ. of Singapore. Dept. of Civil Engineering.
S. L. Ong.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 245-251, April 1985. 2 tab, 13 ref, 1 append.

Descriptors: *Design criteria, *Activated sludge, *Computer models, *Marginal costs, Activated sludge process, Optimization, Mathematical models, Model studies, Mathematical studies, Wastewater treatment.

This article concerns the application of a microcomputer for the design of a least-cost activated sludge system. The activated sludge system is assumed to consist of an aeration tank and a clarifier connected in series. The activated sludge system is modelled as a mathematical programming problem, containing an objective function and a set of constraint equations. The objective function represents the total cost function of the activated sludge system, and the constraint set describes the biological and clarification processes. The resulting model is solved by a random sampling and search region contraction technique. This optimization technique is simple and can easily be adapted to any microcomputer system. From the results of this study, the least-cost design approach is considered to be very effective. (Author's abstract)
W86-04602

TEMPERATURE EFFECTS ON ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEM,
Regina Univ. (Saskatchewan). Faculty of Engineering.
T. Viraraghavan.
Journal of Environmental Health JEVHAH, Vol. 48, No. 1, p 10-13, July/August 1986. 1 fig, 1 tab, 15 ref.

Descriptors: *Biological wastewater treatment, *Aerobic processes, *Anaerobic processes, *Septic tanks, *Temperature effects, Wastewater treatment, Wastewater disposal, Soil temperature, Performance evaluation, Land disposal, Waste disposal, Ottawa, Ontario.

Briefly reviewed are temperature effects on aerobic and anaerobic biological processes relevant to onsite wastewater disposal systems. The onsite systems considered are septic tank systems with conventional soil absorption and mound disposal options, septic tank-anaerobic filter systems, and aerobic package plants. In addition, temperature and performance data on a septic tank and tile field system near Ottawa are presented. In general, winter operation did not pose any special problems in the case of septic tank systems studied. No specific trend between soil temperatures (depth-dependent) and pollutant removal efficiencies could be identified based on the Ottawa study. The anaerobic filter treatment of septic tank effluent shows great promise especially with respect to its use for low temperature operation. In the case of aerobic package units, low air temperatures were found to be not directly responsible for poor operation, as liquid temperatures in the aeration tank were near 20 degrees. (Geiger-PTT)
W86-04606

DEVELOPMENTS IN SLUDGE DEWATERING.
BioCycle BCYCDK, Vol. 27, No. 3, p 22-23, March 1986. 1 tab.

Descriptors: *Dewatering, *Sludge drying, *Sludge thickening, Sludge conditioning, Sludge disposal, Drying, Wastewater treatment, Waste disposal, Sludge filters, Filtration.

Researchers at Battelle Memorial Institute in Columbus, Ohio are making improvements on an electoacoustic dewater process to augment conventional devices such as vacuum filters. This process has much application in composting facilities to reduce the amount of bulking agent required. At a Phoenix, Arizona wastewater treatment facility, solar drying techniques have been tested for several years. Another approach to solar sludge drying has been developed by the Sandia National Laboratories in New Mexico. This process includes a greenhouse, a crossbar conveyor and 12-inch ports for aeration. Further studies are planned by Sandia to balance drying and heating operations for year round use. The Tough Stuff Filtration system developed by the AFL Industries in Riviera Beach, Florida is basically a gravity dewatering process with the weight of the sludge doing the squeezing. Jacksonville, Florida selected a sludge dewatering and disposal system of three centrifuges, combined with two centrifuges installed in place of the plant's original four vacuum filters. This system not only eliminated the dewatering bottleneck, it also reduced polymer costs, electrical costs, and mechanical support costs, while increasing overall sludge cake dryness and throughput. In the paper industry, the most common dewatering technologies include vacuum filters, belt presses and solid bowl centrifuges. There is a trend toward the use of belt presses which can dewater secondary sludges to 12 to 14% solids, primary sludges 35% solids, and primary/secondary sludge mixtures to 16 to 25% solids. (Geiger-PTT)
W86-04612

INDUSTRIAL WASTE CONTROL PROGRAM: MASS BALANCE OF TOXICS IN A MUNICIPAL POLLUTANTS WASTEWATER SYSTEM,
York City Environmental Services Dept., PA.
C. E. Strehl, J. M. Longstreet, and C. S. Smith.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 2, p 10-14, March-April 1986. 2 tabs.

Descriptors: *Water pollution sources, *Industrial wastes, *Wastewater treatment, *Heavy metals, Toxins, Industrial wastewater, Monitoring, Wastewater analysis, Wastewater composition, Waste management, Wastewater facilities, Ammonia, Municipal wastewater, Influent streams.

As part of a plan to upgrade its industrial waste monitoring program in 1984, the York City Wastewater Treatment Plant began monitoring levels of Cd, Cr, Cu, Fe, Pb, Ni, Ag, Zn, and ammonia in the influent industrial loadings to the plant. Significant non-industrial contributions of toxic metals were found in a well controlled system when industrial and non-industrial sources of the pollutants were compared through a system that involved balancing amounts found in industrial and non-industrial wastewaters and the influent of a regional treatment plant. The sum of the industrial and non-industrial contributions of Zn and Cu, the two toxic pollutants of most concern in the York system, were balanced to within 1% and 5%, respectively, of the influent loadings observed at the treatment plant. The small differences observed for these pollutants suggests that the method of mass balancing shows promise for assessing the success of industrial pretreatment pro-

grams and for determining the sources of toxic pollutants in municipal systems. (Geiger-PTT)
W86-04615

PENNSYLVANIA'S PILOT OUTREACH OPERATOR TRAINING PROGRAM,
Commonwealth Engineering and Technology, Inc., Harrisburg, PA.
R. Myers, and C. Kuder.
Water Pollution Control Association of Pennsylvania Magazine, Vol. 19, No. 2, p 18-24, March-April 1986. 2 tab.

Descriptors: *Education, *Training, *Wastewater facilities, Personnel, Benefits, Management planning, Operating policies, Water quality standards, Computer models, Personnel management.

The 1972 Federal Water Pollution Control Act provided funding for the Pennsylvania Pilot Outreach Operator Training Program. The primary objective of the program was to demonstrate that treatment plants unable to meet effluent limitations because of inadequate operator skills can achieve compliance with some outside technical assistance and training. The program was carried out in two phases. In the Diagnostic Evaluation Phase, 20 plants were selected as best suited for training and technical assistance by a computer diagnostic operational modeling program. In the Training Program Phase, the training and technical assistance for the ten plants selected based on the diagnostic evaluation process were organized to systematically correct the deficiencies noted at each plant through intensive, on-site, individual assistance. Questionnaires singled out the plants requiring additional personnel training and assessed the effectiveness of training at each plant. Varying degreres of effluent improvements were achieved as a result of the training program. Documented major improvements where permit effluent limit compliance was achieved were realized at forty percent of the ten plants receiving training. In addition, moderate effluent improvements were observed at four other plants. The information gleaned in this training program will be used in developing a self-sufficient continuing training program in the Commonwealth. (Geiger-PTT)
W86-04616

AUTO-OXIDATION EFFECT ON FLUE GAS SLUDGE SYSTEMS,
R. W. Goodwin.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 10-20, September 1985. 10 fig, 3 tab, 15 ref.

Descriptors: *Dewatering, *Sludge thickening, *Flue gas desulfurization, *Sludge disposal, *Sludge conditioning, Sludge drying, Limestone, Oxidation, Fly ash, Wastewater treatment, Sulfates, Sulfur compounds, Waste disposal.

Upsets to flue gas desulfurization (FGD) sludge treatment systems of coal-fired powerplants may occur under auto-oxidation conditions. A 75-79% auto-oxidized FGD sludge exhibits a mean particle diameter of 45 microns - considerably larger than unoxidized particles. The oxidized sludge reaches terminal settling velocity five times faster than unoxidized material, and settles to higher densities and to thicker underflows. Rakearm overload and blanket consolidation can be avoided by proper drive mechanism design and underflow solids/density control, provided an 8 hr underflow surge/storage tank is recommended instead of thickener sludge blanket storage. Vacuum filtration of an 80% CaSO4 sludge yields 25% greater solids in the cake as compared to a 30% oxidized material. To avoid cake-cracking, the degree of vacuum during incidents of auto-oxidation is reduced, and dual filtrate receivers are provided. Using predictive curves, a transportability analysis was performed on a coal of 0.59-0.91% sulfur and of 10.00-21.50% ash. Either filter by-pass or adding less fly ash to the cake resulted in a 75-85% solids transportability blend and enhanced the blend's landfill suitability. (Geiger-PTT)
W86-04634

GAS-LIQUID INTERACTIONS IN OXYGEN ACTIVATED SLUDGE,
Arkansas State Univ., State University. Dept. of Civil Engineering.
R. C. Clifft, and J. F. Andrews.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 61-77, February 1986. 10 fig, 1 tab, 9 ref, 1 append.

Descriptors: *Activated sludge process, *Models, *Aerobic treatment, *Oxygen, Simulation analysis, Biological wastewater treatment, Computer models, Dissolved oxygen, Mathematical models, Mathematical studies, Alkalinity, Hydrogen ion concentration.

A dynamic model was developed for the gas-liquid interactions of a closed-tank oxygen activated sludge system treating carbonaceous wastes. The model describes gas transfer between phases and accounts for equilibrium changes in the carbon dioxide-bicarbonate buffering system. Computer simulations of a four stage reactor were made to show model predictions when using the conventional gas phase controls. In additions, the effects of changing influent bicarbonate alkalinity, respiratory quotient, and gas-liquid volume ratio were studied. The dissolved oxygen concentration in the fourth stage varied widely and resulted in significant oxygen losses for the conventional control method. Influent bicarbonate alkalinity had a significant effect on pH, but changing the respiratory quotient had only a minimal effect on pH for moderate alkalinity wastewater. The gas-liquid volume ratio had a significant effect on the response time for changing the fourth stage gas composition. (Geiger-PTT)
W86-04641

PERFORMANCE OF DEEP BIOFILM REACTORS,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
M. T. Suidan.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 78-93, February 1986. 8 fig, 2 tab, 15 ref, append.

Descriptors: *Biofilm reactors, *Biological membranes, *Biological treatment, *Biological wastewater treatment, *Graphical methods, Mathematical models, Performance evaluation, Wastewater treatment, Mathematical studies, Biofilters, Anaerobic digestion, Aerobic digestion, Anoxic reactors.

The mathematical relationship between a bulk substrate concentration and the corresponding maximum substrate utilization rate was used in developing design nomograms for completely mixed, and plug-flow biofilm reactors. The graphical procedure can be used to estimate the smallest reactor empty-bed detention time that is needed to achieve a certain degree of waste stabilization. Biofilm reactors that are amenable to analysis using this procedure include fluidized-bed and packed-bed anaerobic, aerobic or anoxic reactors. Studies of the role of the attachment medium particle diameter revealed that the deep-biofilm reactor is extremely sensitive to this surface parameter. The empty-bed detention time in a deep-biofilm reactor was found to vary with the diameter of the medium particle, or with the inverse of the specific surface area of the attachment medium. (Geiger-PTT)
W86-04642

EFFECTS OF CD(II) AND CU(II) ON A BIOFILM SYSTEM,
Missouri Univ.-Rolla. Dept. of Civil Engineering.
S.-Y. Chang, J.-C. Huang, and Y.-C. Liu.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 94-104, February 1986. 5 fig, 2 tab, 18 ref.

Descriptors: *Cadmium, *Copper, *Biological wastewater treatment, *Toxicity, *Biological membranes, Heavy metals, Organic carbon, Sugars, Wastewater treatment, Separation techniques, Performance evaluation.

The toxic effect of Cd(II) and Cu(II) on a fixed-film rotating biological contactor (RBC) in treating a sugar waste was evaluated. Different levels of Cd (5 and 20 ml/L) and Cu (1, 5, 10, 25, and 50 mg/L) were doses to a three-stage RBC unit treating an influent of 300 mg/L sugar solution. Results indicated that the treatment efficiency was not adversely affected by the presence of Cu at a concentration of 10 mg/L or less. However, when the Cu concentrations were increased to 25 and 50 mg/L, removal of dissolved organic carbon was reduced by 7 and 10%, respectively. Toxicity was also observed when Cd concentration was either 5 or 20 mg/L. The majority of the doses metal was effectively retained by the biofilm. The efficiency of metal removal in the treatment system varied from 85 to 95% for Cd, and 30 to 90% for Cu, depending on their initial concentrations in the feed solution. (Geiger-PTT)
W86-04643

MODEL FOR WINTER HEAT LOSS IN UNCOVERED CLARIFIERS,
Green (Howard R.) Co., Cedar Rapids, IA.
D. J. Wall, and G. Petersen.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 123-138, February 1986. 2 fig, 4 tab, 5 ref, 2 append.

Descriptors: *Mathematical models, *Clarifiers, *Heat flow, *Ice formation, Prediction, Computer models, Wastewater treatment, Clarification, Heat transfer, Mathematical studies, Mathematical equations, Temperature effects.

A heat transfer mathematical model was developed to predict the wintertime equilibrium temperatures and potential freezing in primary and secondary wastewaters clarifiers and other open tank. The model estimates equilibrium temperature in an open tank by balancing heat loss due to radiation, convection, and evaporation against heat input from influent flow to the tank and solar and radiation onto the surface of the tank. Data on wind speed, influent water temperature, influent flow, and ambient air temperature were collected and used to predict the clarifier water equilibrium temperature. The predicted water temperatures were then compared against the actual measured water temperatures of full-scale clarifiers. Heat losses in large open tanks such as clarifiers are actually much less than intuition would dictate. Based on the present model, heat losses in open tanks can be estimated under a variety of flow and weather conditions with and without wind breaks. Use of the model could be extended to holding tanks, aerobic digesters, equalization tanks, chlorination tanks, and other open tanks commonly used at wastewater treatment plants. (Geiger-PTT)
W86-04645

ENTEROVIRUSES IN SLUDGE: MULTIYEAR EXPERIENCE WITH FOUR WASTEWATER TREATMENT PLANTS,
Ohio State Univ., Columbus. Dept. of Medical Microbiology.
V. V. Hamparian, A. C. Ottolenghi, and J. H. Hughes.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 280-286, August 1985. 6 tab, 35 ref. EPA Cooperative Agreement No. CS805189.

Descriptors: *Wastewater treatment facilities, *Sludge, *Enteroviruses, Biological analysis, Cultures, Septic sludge, Cell lines, Isolation.

Described are experiences with the isolation of viruses from four treatment plants located in different geographic areas. Over a period of 3 years, 297 enteroviruses were isolated from 307 sludge samples. The highest frequency of viral isolation (92%), including multiple isolates from single samples, was obtained from a treatment plant serving the smallest population. Excluding the polioviruses, 22 different enterovirus serotypes were isolated. The methods used to isolate the viruses were relatively simple and included an elution procedure in which beef extract was used, and a step disinfection. No concentration procedure was used. Of

three cell culture systems used, the RD line of human rhabdomyosarcoma cells was by far the most useful for the isolation of echoviruses. BFGM and HeLa cells were particularly useful for the isolation of group B coxsackieviruses. A seasonal effect on viral isolation rates from sludge was observed. (Lantz-PTT)
W86-04671

5E. Ultimate Disposal Of Wastes

ISOTOPE TECHNIQUES IN THE HYDROGEOLOGICAL ASSESSMENT OF POTENTIAL SITES FOR THE DISPOSAL OF HIGH-LEVEL RADIOACTIVE WASTES.
International Atomic Energy Agency, Vienna (Austria).
For primary bibliographic entry see Field 5B.
W86-03905

ACOUSTICAL METHOD OF BURNING AND COLLECTING OIL SPILLS ON COLD OPEN WATER SURFACES,
Ocean Ecology Ltd., Vancourver (British Columbia).
J. N. Koblanski.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 25-26, 7 fig, 2 ref.

Descriptors: *Oil spills, *Cleanup operations, *Controlled incineration, *Acoustics, *Electrical equipment, *Incineration, Booms, Atomizing.

A completely new method of controlled oil burning with a minimum environmental impact has been developed. Three macrosonic phenomena are combined in one device which is driven into an oil slick. These phenomena are: herding (moving the oil along the surface), levitating and collecting the oil, and atomizing and burning in situ. These functions are so combined as to assist each other. Briefly, two vessels tow a boom through the oil slick. Distributed along the arms of the boom to the central line and also prevent the oil from down draining at the apex in fast current situations. Atomizing and burning transducers as well as a collecting means also are located at the apex. The oil being atomized is ignited easily by a combination of propane torch and high voltage discharge. The unburned but heated oil is suctioned off from the collection area fed by oil levitation transducers. Thus extremely thin and patchy oil may be removed in virtually any environment. The burning may be carried on in populated areas as it is relatively non-polluting. This is due to the combined effect of primary atomization caused by the acoustic energy and secondary atomization caused by the microexplosions of atomized water. Another advantage of this method is the prevention of the sludge formation which results when prevalent standard methods are used. In these in situ methods, the lighter and more volatile materials burn first, leaving a heavy sludge which is difficult or impossible to disperse. The method outlined here burns the volatile and non-volatile portions nonselectively. As a result, no residual sludge is formed. Another advantage of this method is that the prime motivating force applied to the oil is a lightweight transducer having such a low inertia that fast wave situations do not interfere, but serve to increase the burning rate. (Author's abstract)
W86-04004

TESTING OF A PROTOTYPE WASTE OIL FLARING SYSTEM,
Seaward International, Inc., Falls Church, VA.
For primary bibliographic entry see Field 5G.
W86-04005

OIL DEGRADATION AND ENVIRONMENTAL IMPACT OF VARIOUS CO-DISPOSAL METHODS,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
G. Halmo.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 269-272, 3 fig, 3 tab, 3 ref.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, *Degradation, Oil pollution, Biodegradation, Oil.

A study on disposal of oily debris from polluted beaches was performed under laboratory conditions in columns simulating a vertical segment of a landfill. Nine different mixtures of oily debris were tested in parallel, including debris pre-mixed with municipal waste, and mixtures with oil absorbents like pine bark and lime. Fertilizers were used to give an optimum C:N ratio. Oil degradation and leachate formation and composition were studied for one year. The results show that if oily debris, i.e., oily sand, gravel, and seaweed, is placed directly in a landfill leachates will have unacceptably high oil content. When oily sand was mixed with pine bark and seaweed was mixed with pine bark and seaweed was mixed with lime, the disposal experiments showed a complete stabilization of the oil. Lime stabilization, however, caused a leachate of unfavorably high alkalinity. Oxygen appears to be the primary limiting parameter for oil degradation in landfills, and small units or different configurations must be used to improve air diffusion into the mass. Mixing the oily debris with municipal waste had a favorable effect on both biodegradation and stability towards leakage. (Author's abstract)
W86-04024

GEOHYDROLOGY SURROUNDING A POTENTIAL HIGH LEVEL NUCLEAR WASTE REPOSITORY IN THE PALO DURO BASIN, TX,
Battelle Project Management Div., Columbus, OH. Office of Nuclear Waste Isolation.
For primary bibliographic entry see Field 2F.
W86-04064

BATCH COAGULATION OF A LAGOON FOR FECAL COLIFORM REDUCTIONS,
Alberta Univ., Edmonton. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-04116

ROLE OF COAGULATION IN THE KINETICS OF SEDIMENTATION,
Massachusetts Inst. of Tech., Cambridge. Ralph M. Parsons Lab. for Water Resources and Hydrodynamics.
For primary bibliographic entry see Field 5D.
W86-04229

OCCURRENCE, GROWTH, AND SUPPRESSION OF SALMONELLAE IN COMPOSTED SEWAGE SLUDGE,
Maryland Environmental Service, Annapolis.
D. Hussong, W. D. Burge, and N. K. Enkiri.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 887-893, October 1985. 3 fig, 4 tab, 9 ref. AD-12-F-2a-029.

Descriptors: *Sewage Bacteria, *Sludge, *Salmonella, Sludge Disposal, Composting, Microbiological Studies.

Sewage sludge composts from 30 municipalities were sampled for Salmonellae, and four samples (12%) were positive (two contained <0.3/g, and the other two had 21/g and 17,000/g. All 30 composts were inoculated with salmonellae; the populations decreased at a specific death rate of about 0.15/hr over 24 hr at 36 C. In irradiation-sterilized composts inoculated with salmonellae, the salmonellae grew at a rate of 0.65 doubling per hr for >24 hr. Growth and death rates were moisture and flora associated. The growth or death rates for antibiotic-resistant salmonellae were not different from those of nonresistant strains. It is concluded that the active indigenous flora of compost establish a homeostatic barrier to colonization by salmonellae, and in the absence of competing flora, reinoculated salmonellae may grow to potentially hazardous densities. The active microflora of moist composts eliminated contaminating salmonellae (100,000/g) after 6 wk. (Author's abstract)
W86-04234

MIGRATION OF CHLOROPHENOLIC COMPOUNDS AT THE CHEMICAL WASTE DISPOSAL SITE AT ALKALI LAKE, OREGON - 2. CONTAMINANT DISTRIBUTIONS, TRANSPORT, AND RETARDATION,
Oregon Graduate Center, Beaverton. Dept. of Chemical, Biological, and Environmental Sciences.
For primary bibliographic entry see Field 5B.
W86-04242

COMPOSTING REACTION RATE OF SEWAGE SLUDGE IN AN AUTOTHERMAL PACKED BED REACTOR,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
P. D. Bach, M. Shoda, and H. Kubota.
Journal of Fermentation Technology, Vol. 63, No. 3, p 271-278, June 1985. 8 fig, 1 tab, 6 ref.

Descriptors: *Composting, *Sludge Cake, *Packed Beds, Bulking Sludge, Lime.

Dewatered sewage sludge cake was composted in an autothermal packed bed reactor (APBR), in which the temperature of composting material was maintained by the heat of reaction and compared with the results in a continuously mixed isothermal reactor (CMIR). The temperature level in the APBR was controlled by regulating the flow rate of air supplied to the reactor. The composting reaction rate was monitored by the CO2 evolution rate. Sludges containing lime and polymer coagulants gave characteristically different CO2 evolution patterns but no significant difference was detected in the gel chromatographic patterns of water extracts from the final products. The optimal temperature for the composting of both sludges was around 60 C, which was the same as that observed previously for the lime sludge in the CMIR. A difference in the reaction rate between the APBR and the CMIR was clear at the initial stage of the reaction but became smaller as the reaction proceeded. The effect of bulking agents on the reaction rate was also investigated. Bulky agents e.g., rice husks or sawdust, providing a large area of contact between compost solid and air were found to promote the reaction. (Peters-PTT)
W86-04248

CHANNEL FLOW SYSTEM FOR WASTEWATER TREATMENT AND FOOD PRODUCTION,
Osaka Univ. (Japan). Dept. of Environmental Engineering.
For primary bibliographic entry see Field 5D.
W86-04249

PHYSICAL AND CHEMICAL CORRELATES OF MICROBIAL ACTIVITY AND BIOMASS IN COMPOSTING MUNICIPAL SEWAGE SLUDGE,
Cincinnati Univ., OH. Dept. of Biological Sciences.
For primary bibliographic entry see Field 5D.
W86-04254

INFLUENCE OF DEEP OCEAN SEWAGE OUTFALLS ON THE MICROBIAL ACTIVITY OF THE SURROUNDING SEDIMENT,
Dalhousie Univ., Halifax (Nova Scotia). Dept. of Biology.
J. A. Novitsky, and D. M. Karl.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1464-1473, December 1985. 6 fig, 5 tab, 22 ref. National Research Council of Canada A-6548 and T-1925.

Descriptors: *Ocean Dumping, *Outfall Sewers, *Marine Sediments, *Sand, *Microbiological stud-

ies, Wastewater Disposal, Marine Biology, Slime, Biomass, Oahu, Hawaii.

The microbial activity near two deep ocean sewage outfalls off the coast of the island of Oahu, Hawaii, was characterized. Water samples and sediment samples to a depth of 4.5 cm were analyzed from an area of approximately 45,000 sq m surrounding the outfalls. Although the effluent water at both sites exhibited heterotrophic activity that was 2 orders of magnitude greater than water from a control site, ambient water samples taken within 1 m of the discharge ports exhibited activity only twice that of the control water. The heterotrophic activity of the outfall sediment was only elevated above that of the control site for surface samples collected within 10 m of the outfall. The rates of microbial nucleic acid synthesis and carbon production in the sediment were only elevated immediately adjacent to the outfalls. Total microbial biomass, varied spatially but was generally elevated at the outfall sites. The specific growth rates calculated for the sediment microbial populations were not greater at the outfall sites. At one site the rocks surrounding the diffuser pipe were covered with copious amounts of slime that appeared to be composed entirely of microbial cells and filaments. This microbial mat was extremely active with respect to heterotrophic activity and biomass production. These observations suggest that the impact of the sewage discharge on the ambient seawater microbiota is slight and that the effect on the sediment microbiota is confined to an area immediately adjacent to the diffuser ports. In the sand itself, the effect is limited to the upper 2 cm at most. (Author's abstract)
W86-04257

EFFECT OF TEMPERATURE ON COMPOSTING OF SEWAGE SLUDGE,
Tokyo Inst. of Tech. (Japan). Research Lab. of Resources Utilization.
K. Nakasaki, M. Shoda, and H. Kubota.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 6, p 1526-1530, December 1985, 8 fig, 1 tab, 13 ref.

Descriptors: *Composting, *Sludge, *Thermophilic Bacteria, *Temperature Effects, Carbon Dioxide, Bacteria, Respiration.

The effect of temperature on the composting reaction of sewage sludge was investigated at 50, 60, and 70 C. The total amount of CO2 evolved and the final conversion of volatile matter were maximum at 60 C, suggesting that the optimal temperature for composting is around 60 C. The specific CO2 evolution rate (moles of CO2 evolved per hour per viable cell) was maximum at 70 C. The isolated thermophilic bacterium (BH1) which was dominant at 60 C but did not grow at 70 C had a rate of specific 02 consumption (measured on the agar plate) at 70 C four times higher than that at 60 C. This showed that catabolism is dominant at 70 C in the microorganisms indigenous to the compost. Although the specific CO2 evolution rate was higher at 70 C, the optimal temperature for composting is 60 C, the temperature at which there was the maximum CO2 evolution rate. (Peters-PTT)
W86-04259

CHROMIUM MIGRATION THROUGH SLUDGE-TREATED SOILS,
California Univ., Santa Cruz. Dept. of Earth Sciences.
For primary bibliographic entry see Field 5B.
W86-04275

MILE-DEEP REACTOR DESTROYS SLUDGE WITH EASE,
Vertech Treatment Systems, Denver, CO.
G. C. Rappe, and W. L. Schwoyer.
Water Engineering and Management, Vol. 132, No. 10, p 27-29, September 1985. 2 fig.

Descriptors: *Sludge disposal, *Wastewater treatment, *Recycling, *Injection wells, *Sludge digestion, Sludge solids, Biological wastewater treatment, Land disposal, Deep wells.

A below-ground system that successfully converts sludge to an inert ash and a highly biodegradable liquid effluent has been adopted by the Longmont, Colorado Wastewater Treatment Plant. Developed by Vertech Treatment Systems, the system has as its core a reaction vessel which is suspended in a conventionally drilled, cement-encased well that is from 10 to 15 in. in diameter and is one mile deep. Verticle concentric tubes form the annular channels through which the liquid wastes flow during treatment. A heat exchanger is suspended within the vessel to maintain temperature. With the combination of high temperatures and pressures in the reaction vessel, the COD of the influent waste is reduced significantly during its residence time in the oxidation zone of the vessel. The ash produced at Longmont can be used as a filler for brick or disposed of in a sanitary landfill. Its treated effluent is clarified and recycled to the plant's biological treatment process. Research is being done to reduce problems of scaling in the reaction vessel and decrease the amount of nitrate found in the effluent. Effluent recycling is expected to reduce nitrate levels. (Geiger-PTT)
W86-04289

SLUDGE MANAGEMENT METHOD GETS UPDATED,
Black and Veatch, Kansas City, MO.
J. H. Robinson, Jr., and R. D. Kuchenrither.
Water Engineering and Management, Vol. 132, No. 13, p 24-27, December 1985. 4 fig.

Descriptors: *Sludge disposal, *Composting, *Mulching, *Sludge drying, *Solid waste disposal, Land disposal, Waste management, Wastewater facilities, Sludge utilization.

In 1972, the Agricultural Research Service of the U.S. Department of Agricultural began investigating municipal sludge composting at Beltsville, Maryland. The findings of this research are embodied in the Beltsville Aerated-Pile Method of composting which, with some slight modifications, has remained unchanged over the past 12 yr. A properly operated composting system can achieve thermophilic temperatures for several consecutive days, and thereby be successful in eliminating most pathogens, and yielding a useful finished compost. Aerobic composting units can be classified into reactor and non-reactor types. Non-reactor methods can be divided into aerated static pile or windrow processes. Moisture control and materials handling processes are the most important considerations in designing a comosting system. In response to bans on ocean dumping of sludge, the city of Philadelphia started composting digested sludge with wood chips at its Southwest and Northeast plants. Pug mill mixing and aeration are employed for composting along with an elaborate drying system and leachate collection system. In Denver, a windrow composting system was carried out on a pilot scale. As a result of findings on the small scale trials, the 100-dry-ton-per-day operation for Denver incorporates a paved and covered 23-acre composting area, translucent solar roof panels to enhance drying, a fixed aeration system and provisions for odor scrubbing. Combined curing/composting in the windrow method was found to further reduce costs. (Geiger-PTT)
W86-04298

PILOT STUDIES INDICATE COMPOSTING CHOICES,
Camp, Dresser and McKee, Inc., Boston, MA.
J. Donovan.
Water Engineering and Management, Vol. 132, No. 13, p 28-31, December 1985. 2 fig, 2 tab.

Descriptors: *Composting, *Mulching, *Sludge disposal, *Pilot plants, *Land disposal, Landfills, Mulches, Wastewater treatment, Wastewater facilities, Solid waste disposal, Waste disposal.

Pilot plant studies of wastewater sludge composting can be an effective method of tailoring the Department of Agriculture design used at the Beltsville, Maryland location to the requiremetns of other specific locations. A properly designed pilot program can help to obtain information for process design, select equipment, refine cost estimates, produce an end product to determine market and demand, demonstrate the process to plant staff and local officials, and perform chemical and bacteriological analyses on the product. In 1981, the Barrington, Rhode Island plant undertook the task of upgrading its composting facility due to complaints of odor. Two devices were tested, a shredder and an agricultural mixer, to mix the sludge with wood chips. Since the sludge clogged the shredder, its use was discontinued, and local funding was sought to improve the composting facility. At the new advanced wastewater treatment facility in Mansfield, Massachusetts, pilot composting studies were conducted to find effective ways to break up sludge cake. A rotary-hopper grinder was selected which broke up the cake into pieces .5 to 1 inch pieces. The Amherst, Massachusetts facility conducted a demand study to find potential users of its sludge. Following the use of questionnaires and meetings, the facility found that demand for its municipal sludge which was classified Type I was twice the yearly production. The Haverhill Massachusetts facility composted its sludge with wood chips. Average temperatures did not reach the 55 degree standards, but pathogen kill was reported as good. (Geiger-PTT)
W86-04299

TRANSIENT MOVEMENT AND TRANSFORMATION OF CARBON SPECIES IN SOIL DURING WASTEWATER APPLICATION,
California Univ., Davis. Dept. of Land, Air and Water Resources.
A. N. Angelakis, and D. E. Rolston.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1141-1148, August 1985. 7 fig, 1 tab, 24 ref.

Descriptors: *Wastewater disposal, *Land disposal, *Carbon, *Soil, *Solute transport, *Mathematical models, Kinetics, Numerical analysis, Mathematical equations, Mathematical studies, Carbon dioxide, Organic carbon, Path of pollutants, Fate of pollutants.

The transport of three C species (insoluble, soluble, and gaseous) in soil were mathematically described as functions of depth and time, subject to intervals of $0<t<or = tl$ and $tl<t<or = t(max)$, where tl refers to time of application of insoluble and/or soluble C. Convective and convective-dispersive transport for the first and second C species, respectively, gas diffusion for the third species, and first-order kinetics as a transformational mechanism were assumed. Linear adsorption isotherms for the first two species and a constant gas solubility were also assumed. Combined analytical and numerical solutions of three coupled partial differential equations were developed. The numerical model was used to study the microbial mineralization of organic C transformed under a biophasic scheme by applying a primary wastewater effluent to top-soil columns. Distribution of insoluble C concentrations were accurately predicted, particularly at large times. On the other hand, soluble C profiles were more accurately predicted at early times and shallow depths than for $t<tl$ and large depths. Fitted gaseous diffusion coefficients were required to describe the measured CO2 profiles instead of those measured in the top of the soil columns. Gaseous C profiles were accurately predicted, especially at early times and shallow depths. (Author's abstract)
W86-04311

INDUSTRIAL WASTES AND PUBLIC HEALTH: SOME HISTORICAL NOTES, PART I, 1876-1932,
Carnegie-Mellon Univ., Pittsburgh, PA.
J. A. Tarr.
American Journal of Public Health, Vol. 75, No. 9, p 1059-1067, September 1985. 4 fig, 64 ref.

Descriptors: *Industrial wastes, *Policy making, Water pollution control, History, Priorities, Public policy.

The positions of public health professionals on the disposal of industrial wastes in waterways are ex-

plored for the period from 1876 through 1932. Major themes discussed include the rationale for setting priorities about human and industrial pollution; the relationship between industrial wastes and water supplies; and the development of indicators for the presence and measurement of industrial wastes. Industrial wastes were accorded a relatively low priority by the public health community compared to human wastes because of the potential for acute health effects from human wastes compared with the belief that industrial wastes had only indirect effects. A relatively small group of professionals argued for attention to the indirect health effects of industrial wastes and their impacts on the total stream environment. The final significant development regarding industrial pollution and public health was the formulation by Streeter and Phelps of the Public Health Service of a theory of stream purification with a set of general quantitative indicators. The Streeter-Phelps model enhanced the possibility of successful control by circumventing the problem of the heterogeneous nature of organic industrial effluents. (Rochester-PTT)
W86-04327

PERCENTILE ESTIMATION PROCEDURES FOR WATER QUALITY MANAGEMENT,
Water Research Centre, Swindon (England). Swindon Engineering Centre.
For primary bibliographic entry see Field 7C.
W86-04340

OPTIMAL DISCHARGE PROFILES FOR SUDDEN CONTAMINANT RELEASES IN STEADY UNIFORM OPEN-CHANNEL FLOW,
N. C. Daish.
Journal of Fluid Mechanics, Vol.159, p 303-321, October 1985. 7 fig, 12 ref.

Descriptors: *Discharge profiles, *Pollutant releases, *Open-channel flow, *Variance maximization, Topography, Slopes, E-folding.

The effect of varying the initial concentration distribution is investigated for sudden contaminant release in a uniform straight channel. Taking the optimal choice to be that which maximizes the variance of the contaminant cloud far downstream, it is found that, unless the topography is very unusual, the largest variance can be generated by splitting the contaminant into two parts, placing the larger part at the bank where the channel bed slopes most greatly, and the remainder near to where the channel is deepest. This procedure significantly reduces peak concentrations far downstream when compared with making the entire release at any single point across the flow. Even at distances as large as six times the e-folding distance for cross-sectional for cross-sectional mixing, the splitting of the discharge is shown to reduce the peak concentrations by a third. (Author's Abstract)
W86-04344

HEALTH RISK COMPARISON BETWEEN GROUNDWATER TRANSPORT MODELS AND FIELD DATA,
Environmental Protection Agency, Washington, DC. Office of Research and Development.
For primary bibliographic entry see Field 5B.
W86-04397

METAL MOVEMENT IN SLUDGE-TREATED SOILS AFTER SIX YEARS OF SLUDGE ADDITION: 2. NICKEL, COBALT, IRON, MANGANESE, CHROMIUM, AND MERCURY,
California Univ., Berkeley. Dept. of Plant and Soil Biology.
For primary bibliographic entry see Field 5B.
W86-04408

FATE OF DI-2-(ETHYLHEXYL)PHTHALATE IN THREE SLUDGE-AMENDED NEW MEXICO SOILS,
For primary bibliographic entry see Field 5B.
W86-04413

RESIDUAL CADMIUM FORMS IN ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-04414

PLANT UPTAKE OF CADMIUM FROM ACID-EXTRACTED ANAEROBICALLY DIGESTED SEWAGE SLUDGE,
Pennsylvania State Univ., University Park. Dept. of Agronomy.
For primary bibliographic entry see Field 5B.
W86-04415

DISTRIBUTION OF PLUTONIUM AND AMERICIUM BENEATH A 33-YR-OLD LIQUID WASTE DISPOSAL SITE,
Los Alamos National Lab., NM.
For primary bibliographic entry see Field 5B.
W86-04416

EFFECT OF NITRILOTRIACETIC ACID ON THE SOLUBILITIES OF METALS IN SOIL-SLUDGE MIXTURES,
Imperial Coll. of Science and Technology, London (England). Dept. of Civil Engineering.
K. Garnett, P. W. W. Kirk, J. N. Lester, and R. Perry.
Journal of Environmental Quality JEVQAA, Vol. 14, No. 4, p 549-553, October-December 1985. 10 fig, 2 tab, 26 ref.

Descriptors: *Chelating agents, *Metal complexes, *Sludge disposal, *Nitriloacetic acid, Copper, Manganese, Nickel, Lead, Zinc, Hydrogen ion concentration, Solubility, Soil.

The effect of nitrilotriacetic acid (NTA) on the solubilities of Cu, Mn, Ni,Pb, and Zn in soil/sludge mixtures was investigated in batch equipments. Soil samples from Wye Coombe series (silt-loam, Rendolic Eutrochrepts) and Essex Windsor series (clay-loam, Haplaquepts) were each mixed with anaerobically digested sewage sludge and teh influence of extraction time, NTA concentration, and pH on the solubility of NTA and metals was assessed. Removal of NTA from the liquid phase by soil/sludge colloids became constant after 8 h and was attributed to adsorption. The concentration of soluble Ni, Pb, and Zn increased in both soil/sludge mixtures with increases in NTA concentration from 0 to 0.212 mmol/L. Manganese was the least affected by the addition of NTA, and pH was shown to be the overriding influence on its solubility. In the Essex soil/sludge mixture, increasing the NTA concentration from 0 to 0.005 mmol/L caused a sharp decrease in Cu solubility, with higher NTA concentrations having no further effect on soluble Cu levels. Addition of NTA did not significantly change Cu solubility in the Wye soil/sludge mixture. These results provide a basis to design further experiments to determine if increased heavy metal solubility could result if sludge containing NTA was applied to agricultural land. (Author's abstract)
W86-04420

BIOLOGICAL TREATMENT OF HAZARDOUS WASTE IN SEQUENCING BATCH REACTORS,
CECOS International, Niagara Falls, NY.
For primary bibliographic entry see Field 5D.
W86-04504

TREATMENT OF OIL IN REFINERY WASTEWATER IN SOUTH EAST ASIA,
Burt Consultants Pty Ltd., Singapore.
For primary bibliographic entry see Field 5D.
W86-04512

TWO OPTIONS FOR TREATMENT OF ACIDIC ORGANIC INDUSTRIAL WASTES,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
For primary bibliographic entry see Field 5D.
W86-04561

WATER TREATMENT BY MEANS OF ACTIVATED CARBON, PREPARED FROM LOCALLY AVAILABLE WASTE MATERIALS (II),
Vrije Univ., Brussels (Belgium). Dept. of Industrial Chemistry.
For primary bibliographic entry see Field 5D.
W86-04565

WASTE MANAGEMENT PLANNING,
Durham Univ. (England). Faculty of Law.
For primary bibliographic entry see Field 5G.
W86-04590

TEMPERATURE EFFECTS ON ONSITE WASTEWATER TREATMENT AND DISPOSAL SYSTEM,
Regina Univ. (Saskatchewan). Faculty of Engineering.
For primary bibliographic entry see Field 5D.
W86-04606

USE OF IRON RODS TO DETERMINE THE DEPTH OF SEASONAL WATER TABLES FOR ABSORPTION FIELDS IN SEWAGE DISPOSAL SYSTEMS,
South Carolina State Dept. of Health and Environmental Control, Charleston.
F. G. Spinale, and W. H. McKee, Jr.
Journal of Environmental Health JEVHAH, Vol. 48, No. 1, p 26-27, July/August 1985. 1 fig, 1 tab, 2 ref.

Descriptors: *Measuring instruments, *Water level, *Waste disposal, Piezometers, Septic tanks, Seasonal variation, Wastewater disposal, Water table, Monitoring.

Comparisons of rust formation on iron rods with results obtained by using conventional piezometers indicate that iron rods will accurately measure the average depth to seasonal water tables for evaluation of sites for septic tank absorption fields. The use of iron rods was found to be less expensive in terms of material and manpower and is recommended as a supplement to the use of conventional piezometers for determining seasonal water table measurement on imperfectly drained soils. (Author's abstract)
W86-04608

DEVELOPMENTS IN SLUDGE DEWATERING.
For primary bibliographic entry see Field 5D.
W86-04612

USING ORGANIC WASTES IN TENNESSEE,
Tennessee Univ., Knoxville. Inst. of Agriculture.
J. D. Wolt.
BioCycle BCYCDK, Vol. 27, No. 3, p 24-25, March 1986.

Descriptors: *Manure, *Animal wastes, *Sludge disposal, *Waste disposal, *Farm wastes, Organic wastes, Land disposal, Fertilizers, Nitrogen, Wastewater disposal, Industrial wastes, Municipal wastes, Fertilization, Feedlot wastes.

The University of Tennessee Agricultural Experiment Station in Knoxville is conducting studies to investigate the effects of applying manure and industrial and municipal sludge on forage crops. At the Dairy Experiment Station in Lewisburg, liquid dairy manure was either injected or broadcast in fall and spring and was compared to conventional inorganic nitrogen fertilization on pastures planted with corn. Results showed that neither time nor method of application influenced crop yield or nutrient content to a significant degree where manure was applied to a site which had continuously received broadcast application of dairy manure for several years. At the Ames Plantation at Grand Junction, liquid swine waste was injected into Loring silt loam at a rate of 1 dry ton/acre from September to May. Corn silage yields varied with the month of application in all three years. Spring applications consistently produced yields comparable to those resulting from conventional nitrogen fertilization. Dewatered industrial sludge

from E. I. DuPont was applied to bermuda grass grown on Statler sandy loam and on wheat and rye grown on Sequatchie silt loam. A variety of trace elements were found that could pose an environmental hazard if improperly managed on cropland. Municipal sludge from the Maryville Regional Wastewater Treatment Plant was applied to limed and unlimed plots. Although nitrogen yields were comparable to conventional nitrogen fertilization, Zn levels were a limiting factors. (Geiger-PTT)
W86-04613

STRAW-BASED TECHNIQUES FOR COMPOSTING,
Birmingham Univ. (England). Wolfson Compost Studies Group.
A. J. Biddlestone, K. R. Gray, and D. J. Cooper.
BioCycle BCYCDK, Vol. 27, No. 3, p 40-44, March 1986. 2 tab, 4 ref.

Descriptors: *Composting, *Farm wastes, *Animal wastes, *Straw, *Feedlot wastes, Waste disposal, Manure, Sludge disposal, Slurries.

This paper describes the joint work done by the University of Birmingham in England and industry to mitigate the problems arising from farm effluent disposal. A reliable method for blending slurries and straw on a large scale is available using the Armix Processor. The processor uses straw which itself presents a disposal problem in the United Kingdom, and blends it with organic animal waste slurries or vegetable wastes of high moisture content for composting in Arcub cubicles. The straw-slurry mixture can be composted with reasonably low air pressure drops and this method shows much potential in the future treatment of sewage sludges. Since the straw can absorb considerable quantities of liquor, the technique can overcome silage liquor problems and may be applied to the recycling of certain food industry wastes for animal feedstuffs. It also has potential for the deep filtration of organic slurries, through which is removed a much higher proportion of the suspended solids than can be achieved with mechanical, screen-type slurry separators. The active compost heaps are useful in removing many offensive odors. (Geiger-PTT)
W86-04614

AUTO-OXIDATION EFFECT ON FLUE GAS SLUDGE SYSTEMS,
For primary bibliographic entry see Field 5D.
W86-04634

SOLID WASTE MANAGEMENT FOR UTILITY RECONVERSIONS,
Stone and Webster Management Consultants, Inc., New York.
For primary bibliographic entry see Field 5G.
W86-04635

FIELD AGING OF FIXED SULFUR DIOXIDE SCRUBBER WASTE,
Maryland Univ., College Park. Dept. of Civil Engineering.
M. S. Aggour, W. D. Stanbro, and J. J. Lentz.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 62-73, September 1985. 13 fig, 4 tab, 7 ref.

Descriptors: *Landfills, *Fly ash, *Waste disposal, *Sludge disposal, *Design criteria, Pilot plants, Land disposal, Weathering, Degradation, Linings, Waste dumps, Sulfur compounds, Aging.

A fixed-material test pad was constructed to evaluate the long-term effects of the fixation with lime of blended fly ash and scrubber sludge. The test pad was used as a scale model disposal site and the fixed material was tested at the time of pad construction in 1979 and again in 1983. The study included field and laboratory evaluation of the physical and chemical properties of the four-year-old fixed scrubber sludge. Results indicated that the undeteriorated fixed fly ash-scrubber mixture is a very acceptable material for disposal by landfilling or storage in piles where foundation conditions are unlikely to produce fracturing of the material. Since the material undergoes considerable weathering, for deposition of the material in a pile, the manner of placement is of utmost importance. The influx of oxygen-rich-rainwater induces oxidation to a more soluble material. An overdrain system is desirable to prevent infiltration of water into the material, and a nonfrost-susceptible soil cover can help reduce the chemical transformations as well as the mechanical weathering. When an embankment is constructed in stages with long periods of time intervening between the successive stages, weathering and chemical changes could cause substantially degraded structural properties. (Geiger-PTT)
W86-04636

CLAY LINER CONSTRUCTION AND QUALITY CONTROL,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
For primary bibliographic entry see Field 5G.
W86-04638

PRACTICAL APPLICATION OF THEORETICAL MODELS TO MAGNETOMETER SURVEYS ON HAZARDOUS WASTE DISPOSAL SITES - A CASE HISTORY,
Illinois State Geological Survey Div., Champaign.
R. H. Gilkeson, P. C. Heigold, and D. E. Layman.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 54-61, Winter 1986. 12 fig, 12 ref. EPA Cooperative Agreement No. R810442-01-7.

Descriptors: *Magnetic studies, *Hazardous materials, *Land disposal, *Theoretical analysis, Model studies, Case studies, Trenches, Field tests, Mathematical models, Wilsonville, Illinois.

Wastes were to be exhumed and removed from a hazardous and chemical waste disposal site that was situated near the town of Wilsonville, Illinois. This landfill operation was a trench and fill procedure that relied on natural attenuation of contaminants by the native geological materials. The site was 130 acres, with individual trenches 10-20 feet deep, 150-300 feet long and 50-100 feet wide. Theoretical two-dimensional models were used to evaluate the application of magnetic methods to define trench boundaries on the disposal site. The models predicted that both the total field and the vertical component anomalies were diagnostic; however, the vertical component anomaly was more focused on the trench boundaries. A survey with a vertical component fluxgate magnetometer was successful in defining trench boundaries. Observations made along traverses that trended perpendicular to the long axis of the parallel trenches indicated vertical magnetic intensity values with a cyclical pattern of large positive values over trenches and large negative values over intertrench corridors. Vertical magnetic intensity values determined with theoretical two-dimensional models compared favorably to the observed vertical magnetic values. The models were used to constrain the interpretation of the field observations to define trench boundaries; the magnetic survey defined trench boundaries with an accuracy within + 2 feet. (Lantz-PTT)
W86-04654

5F. Water Treatment and Quality Alteration

PREDICTING THE REMOVAL OF SOLUBLE ORGANIC CONTAMINANTS BY LIME SOFTENING,
National Chunghsing Univ., Taichung (Taiwan). Dept. of Environmental Engineering.
M. Y. Liao, and S. J. Randtke.
Water Research WATRAG, Vol. 20, No. 1, p 27-35, January 1986. 1 fig, 5 tab, 43 ref.

Descriptors: *Water treatment, *Organic compounds, *Lime softening, Adsorption, Polymers, Phenols, Industrial wastes, Organophosphorus compounds.

The removal of organic contaminants by lime softening and molecular characteristics influencing removal were experimentally and theoretically examined. Coprecipitation appeared to be the major removal mechanism for organic substances in low concentrations, and only those substances able to adsorb onto CaCO3 were able to be removed by lime softening. All of the removable anionic compounds were able to coordinate with Ca(2+) to form relatively insoluble complexes. Fatty acids, which form relatively soluble complexes with Ca(2+) and hydrophobic chemicals unable to coordinate with Ca(2+) were not removed. Molecular characteristics influencing removal included molecular charge, functionality, degree of polymerization, molecular geometry and affinity for water. In general, softening is effective in removing polymeric electrolytes possessing acidic oxygen-containing residues, such as carboxyl, phenol, enol, phosphoryl, phosphonyl,sulfuryl and sulfonyl groups. Simple monomeric molecules are not expected to be effectively removed unless they polymerized or possess phosphorus-containing functional groups such as phosphoryl and phosphonyl. (Author's abstract)
W86-04105

LOW TECHNOLOGY WATER PURIFICATION BY BENTONITE CLAY FLOCCULATION AS PERFORMED IN SUDANESE VILLAGES: VIROLOGICAL EXAMINATIONS,
Kongelige Veterinaer- og Landbohoejskole, Copenhagen (Denmark). Dept. of Veterinary Virology and Immunology.
E. Lund, and B. Nissen.
Water Research WATRAG, 20, No. 1, p 37-43, January 1986. 9 tab, 23 ref.

Descriptors: *Water treatment, *Flocculation, *Bentonite, *Sudan, Nile River, Drinking water, Viruses, Suspended solids, Water renovation, Water reuse.

During the flood season (June-September), the Nile River in Sudan, is highly turbid. Suspended solids may be as high as 8000 mg/l. In the villages, water purification by flocculation has been employed for over 100 years, using 'rauwaq' clarifier (a local clay) and bentonite. A suspension of rauwaq is prepared and added to turbid water. If the proper rauwaq concentration is used, flocs will form and settle, after at least 1 hr of purification. Noting that villages employing this method of water purification suffer from fewer gastrointestinal disturbances, the authors report here on a study to determine the effectiveness of the technique for virus removal. Results indicate that with proper flocculation, 3 to 4 log units of virus could be removed. Conditions for floc formation are discussed. (Lantz-PTT)
W86-04106

EFFECT OF OPERATION CONDITIONS ON BIOLOGICAL FE(2+) OXIDATION WITH ROTATING BIOLOGICAL CONTACTORS,
Tohoku Univ., Sendai (Japan). Dept. of Civil Engineering.
K. Nakamura, T. Noike, and J. Matsumoto.
Water Research WATRAG, Vol. 20, No. 1, p 73-77, January 1986. 7 fig, 1 tab, 7 ref.

Descriptors: *Rotating biological contactors, *Iron oxides, *Acid mine drainage, *Biological oxidation, Hydrogen ion concentration, Oxidation rate, Iron, Oxidation, Ferrobacillus, Japan, Mine drainage.

Oxidation of ferrous iron (Fe(2+)) by acidophilic iron-oxidizing bacteria was conducted with a laboratory-scale rotating biological contactor (RBC) in order to investigate the effects of Fe(2+) concentration, pH, temperature and rotation rate. Fe(2+) oxidation rate on RBC was expressed as a first-order reaction with respect to Fe(2+) concentration when it was below 150 mg/l. Fe(2+) oxidation rate was not affected by pH from 1.0 to 2.6 nor by temperatures from 10 to 40 C, but was accelerated by increasing peripheral disk velocity from 4.7 to 28.2 m/min. (Author's abstract)
W86-04111

VOLATILE OZONIZATION PRODUCTS OF AQUEOUS HUMIC MATERIAL,
Bristol Univ. (England). Organic Geochemistry Unit.
S. D. Killops.
Water Research WATRAG, Vol. 20, No. 2, p 153-165, February 1986. 6 fig, 4 tab, 45 ref.

Descriptors: *Humic acids, *Fulvic acids, *Ozonation, *Water treatment, *Volatile solids, Natural waters, XAD-2 resin, Carbonyl group formation, Gas liquid chromatography, Nuclear magnetic resonance.

Humic and fulvic acid samples, extracted from river water, and two upland waters with high humic content were studied. Aqueous solutions were effectively decolorized by ozonation (< or = to 3 mg ozone/mg humic substance), although significant alteration of the bulk humic material was not detected. The greater proportion of the material remained as polymeric structures, and typically <10% comprised relatively volatile material, which was isolated by XAD-2 resin and subjected to GC-MS analysis. GC-MS analysis. GC-MS analysis provided some evidence for the formatioon of carbonyl groups (chiefly COOH) among the volatiles from the humic and fulvic acids. Apart from the fulvic acid, ozonation failed to increase the amount of volatile components extracted by XAD-2 resin. The volatiles chiefly appeared to be species trapped in the macromolecular structure of the humic material. Some changes were noted among the volatiles of fulvic and humic acids following ozonation (e.g., increase in n-alkanes and disappearance of alkylnaphthalenes), but volatiles from the upland waters appeared more resistant towards oxidation. (Author's abstract)
W86-04122

ACTION OF OZONE ON METHYL OCTADEC-9-ENOATE IN POLAR SOLVENTS: A MODEL FOR AQUEOUS OZONIZATION OF ORGANIC COMPOUNDS,
Bristol Univ. (England). Organic Geochemistry Unit.
S. D. Killops.
Water Research WATRAG, Vol. 20, No. 2, p 167-171, February 1986. 4 fig, 2 tab, 7 ref.

Descriptors: *Methyl octadec-9-enoate, *Polar solvents, *Water treatment, Aldehydes, Carboxylic acids, Acetals, Hydroxyl radicals, Methoxy radicals, Gas liquid chromatography, Organic compounds.

Aqueous ozonization of methyl octadec-9-enoate resulted in aldehyde and carboxylic acid group formation at the fragmented C=C bond. High ozone doses lead to increased oxidation of aldehyde to carboxylic acid groups. Methanolic ozonization produced dimethyl acetal groups in preference to aldehyde groups, and methylation of carboxylic acid groups was noted. Analysis of reaction products was performed by capillary GLC and GC-MS. Results were consistent with radical attack (*OH or *OMe) for ozonization in polar solvents. (Author's abstract)
W86-04123

REMOVAL OF NITRATE IN DRINKING WATER BY ION EXCHANGE - IMPACT ON THE CHEMICAL QUALITY OF TREATED WATER,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
M. Dore, Ph. Simon, A. Deguin, and J. Victot.
Water Research WATRAG, Vol. 20, No. 2, p 221-232, February 1986. 14 fig, 7 tab, 22 ref.

Descriptors: *Drinking water, *Denitrification, *Ion exchanged, *Water quality, *Adsorption, Styrene, Divinylbenzene, Trimethylamine, Nitrates, Aromatic compounds, Chlorinated hydrocarbons, Herbicides, Nitrosamines.

The increase in nitrate concentration in public water supplies is becoming an important problem in certain countries. Among the treatment processes available, the removal of nitrates by ion exchange has been thoroughly studied in recent years with regard to problems of capacity and selectivity. The use of anionic resins in drinking water treatment imply that these compounds do not induce secondary degradation in the quality of the treated water. The purpose of this paper is to examine the chemical quality of water treated by a strong base ion exchange resin (IRA 400) regenerated by sodium chloride. Two sources of organic compounds can be found in water treated with a filter of ion exchange resin: The constitution monomers leached from IRA 400 (styrene, divinylbenzene, trimethylamine and their derivatives). The micropollutants are liable to be absorbed, desorbed or produced during the exhaustion cycles of denitratation. The evolution of the concentration synthesis monomers in treated water was studied during the conditioning and the exhaustion cycles of the resin. Moreover the adsorption isotherms of the IRA400 for different kinds of micropollutants (aromatic compounds, chlorinated solvents, herbicides, nitrosamines) were determined and the concentration of an added micropollutant (phenol) was measured during an exhaustion cycle. As for the formation of organic compounds during the treatment, we have limited our study to the analysis of N-dimethylnitrosamine during the exhaustion cycle, since this compound has been detected in water demineralized by an ion exchange resin. (Lantz-PTT)
W86-04128

DEVELOPMENTS OF TOTAL KIELDAHL NITROGEN AND BACTERIAL BIOMERS ALONG A POTABITTIZATION LINE.
Montpellier-2 Univ. (France).
Water Research WATRAG, Vol. 20, No. 2, p 237-245, February 1986. 4 fig, 4 tab, 17 ref.

Descriptors: *Potable water, *Kjeldahl nitrogen, *Biomass, *Bacteria, Drinking water, Nitrogen compounds, Ammonia, Oise River, France, Chlorination, Ozonation, Disinfection, Escherichia coli, Epifluorescence.

Quality standards relative to water distributed for human consumption are increasingly stringent; the authorized rate of total Kjedahl nitrogen (TKN) in particular has been fixed at 1 mg N/l by EEC standards (Guideline of 15 July 1980). The behavior of this parameter has been monitored throughout the treatment line at the Mery-sur-Oise potable waterworks of the Suburban Paris Water Authority (Val d'Oise, France), this also includes the physiochemical and biological stages. Total Kjeldahl nitrogen which corresponds to organic Nitrogen (N sub org.) and ammonia nitrogen (N-NH4(+)) is measured by Kjeldahl method. Ammonia nitrogen is measured by the indophenol modified blue method as described in AFNOR. In order to study the possible influence of total bacteria on the evolution of TKN, a bacteria count is conducted by epifluorescent microscopy and by spreading on solid culture media. The first of these techniques makes it possible to count separately the 'active' bacteria (red fluorescence) and the 'inactive' bacteria (green fluorescence). The second detects only the bacteria capable of forming colonies on non-selective media (Agar nutrient). Water sampled from the river Oise upstream from the waterworks shows a remarkably constant low TKN content whatever the season. Following clarification and filtration, this water is disinfected by ozonation and chlorination. The effect of these two oxidizing agents on organic nitrogen compounds seems complex since two opposite trends can occur, i.e., the nitrogenous concentration can either increase or decrease compared with the previous stage of treatment. Since we know that the Kjeldahl method does not enable all the organic nitrogen compounds to be measured it is logical to suppose that these trends are only an appearance due to the transformation of the chemical structure, can become measurable by the Kjeldahl method while others become refractory. Several mechanisms have been suggested in connection with the action of ozone, e.g., lysis of the bacteria, effect on the enzymatic system and effect on nuclear structure. In the latter case, it is possible that ozone denatures the DNA so that it loses its double-strand structure, each single strand reacting towards the fluorochrome like an RNA. The bacteria would then appear to be active. Ozone might also affect the RNA in such a way that it stops reacting with the fluorochrome and then only the green color produced by the acridine orange DNA compound is perceptible. The hypothesis according to which there is only a temporary loss of the ability to form colonies, hence to reproduce, immediately after ozonation remains to be proved. (Lantz-PTT)
W86-04130

PREDICTION OF MULTICOMPONENT ADSORPTION EQUILIBRIA USING IDEAL ADSORBED SOLUTION THEORY,
For primary bibliographic entry see Field 5D.
W86-04136

SUCCESSFUL ABATEMENT OF LEAD EXPOSURE FROM WATER SUPPLIES IN THE WEST OF SCOTLAND,
Glasgow Univ. (Scotland). Dept. of Medicine.
For primary bibliographic entry see Field 5C.
W86-04146

PREFORMED MONOCHLORAMINE USED AS A POST-DISINFECTANT IN DRINKING WATER TREATMENT AT SJAELSO WATER WORKS,
Gentofte Municipal Water Supply (Denmark).
J. Beck, J. B. Dyhm, and P. K. Jensen.
Aqua AQUAAA, No. 1, p 25-33, 1986. 17 fig, 4 tab, 15 ref.

Descriptors: *Monochloramine, *Water treatment, *Chlorination, *Disinfection, *Drinking water, *Sjaelso Water Works, Denmark, Groundwater, Surface water, Chemical treatment, Bacterial analysis, Escherichia coli, Pseudomonas, Preformed monochloramine.

A new advanced technological method for post-disinfection has been developed at Sjaelso Water Works, Denmark, using a concentrate of well-defined and stable monochloramine. The method is in practical use for the post-disinfection of water from three plants, treating two types of ground water and a surface water where ozone is used as the main disinfectant. the conditions for the production of the preformed monochloramine concentrate were established by pilot scale experiments. The practical details and design features for the full-scale operation together with the safety and control measures to be incorporated into the design of the monochloramine production and dosage unit are presented in detail. The efficiency of preformed monochloramine as a disinfectant was examined by laboratory experiments with E. coli and Ps. fluorescens as tests organisms. Routine bacteriological examinations at sampling points throughout the distribution system have furthermore shown that a satisfactory post-disinfection was achieved. The chemical stability of monochloramine was investigated by sampling and in situ analysis for chloramines of a water plug passing through the mains under conditions of constant flow. Preformed monochloramine proved to be a relatively stable disinfectant compared with the less well-defined combined chlorine/chloramination. The use of preformed monochloramine has the advantage that the presence of dichloramine and trichloramine, which are responsible for taste and odor problems, is avoided, and there is no formation of trihalomethanes. (Author's abstract)
W86-04152

WATER SUPPLY BY OPTIMAL MIXING OF WATERS OF VARIABLE QUANTITY AND QUALITY,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
A. B. Shahalam, A. H. Al-Ahamed, and A. R. Mansour.
Aqua AQUAAA, No. 1, p 45-49, 1986. 3 fig, 5 tab, 3 ref.

Descriptors: *Water supply development, *Mixing, *Water quality management, Impaired water use,

Drinking water, Optimization models, Water demand, Jordan.

Presented is a methodology for optimal mixing of waters from multiple sources. The mixing is performed in such a way so that the quality of after-mix water satisfies the prescribed standards of drinking water while the amount of total supply is maximized. In the process, the cost of water treatment and transportation is minimized. The problem has been formulated as a linear optimization model. The output of the model includes optimal water procurement cost and optimal amounts of water desired to be extracted from various sources. The model can be used to determine the minimal treatment required in order to satisfy the area demand provided the combined safe yield of all sources remains equal or more than the demand. In case of demand exceeding the combined safe yield of all available sources, the model can be used to determine the minimal volume and quality of shortage. Such informations can be subsequently utilized for exploration of new sources. The use of the model has been demonstrated in a special case of water supply in a northern district of Jordan. (Lantz-PTT)
W86-04154

EFFECTS OF EXPOSURE TO SALTY DRINKING WATER IN AN ARIZONA COMMUNITY: CARDIOVASCULAR MORTALITY, HYPERTENSION PREVALENCE, AND RELATIONSHIPS BETWEEN BLOOD PRESSURE AND SODIUM INTAKE,
Centers for Disease Control, Atlanta, GA. Div. of Chronic Disease Control.
For primary bibliographic entry see Field 5C.
W86-04223

HOLDING EFFECTS ON COLIFORM ENUMERATION IN DRINKING WATER SAMPLES,
Environmental Monitoring and Support Lab.-Cincinnati, OH. Biological Methods Branch.
A. E. McDaniels, R. H. Bordner, P. S. Gartside, J. R. Haines, and K. P. Brenner.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 4, p 755-762, October 1985. 7 fig, 2 tab, 13 ref.

Descriptors: *Coliforms, *Drinking Water, *Bacterial Analysis, Water Analysis, Microbiological Studies, Heterotrophic Bacteria.

Standard procedures for analyzing drinking water stress the need to adhere to the time and temperature conditions recommended for holding samples collected for microbiological testing. Research was conducted by standard analytical methods to determine if changes occurred when samples were held at 5 and 22 C and analyzed at 0, 24, 30, and 48 hr. Samples were analyzed for coliforms by the membrane filter and fermentation-tube procedures and for heterotrophs by the pour plate method. A total of 17 treated water samples were collected from a large municipal distribution system from August to December 1981, and 12 samples were collected from January to May 1983. The samples were dosed with coliforms previously isolated from the water system, Enterobacter cloacae in 1981 and Citrobacter freudii in 1983. The coliform counts declined linearly over time, and the rates of decline were significant at both 5 and 22 C. Within 24 hr at 22 C, levels of E. cloacae and C. freundii decreased by 47 and 26%, respectively, and at 5 C, E. cloacae numbers declined by 23%. Some samples with initially unacceptable counts (>4/100 ml) met the safe drinking water limits after storage for 24 hr at 5 and 22 C and would have been classified as satisfactory. In contrast to the coliform losses, heterotrophic plate counts of samples held at 22 C for 30 and 48 hr increased by 0.5 to 2.5 orders of magnitude and often interfered with coliform counts on the membrane filter. Heterotrophic counts of the same samples held at 5 C for 30 and 48 hr declined slightly. It is recommended that drinking water samples be iced and that they be analyzed as soon as possible on the day of collection to minimize changes in bacterial densities. (Author's abstract)
W86-04233

SELECTIVE MEDIUM FOR THE ISOLATION OF OPPORTUNISTIC FLAVOBACTERIA FROM POTABLE WATER,
National Hansen's Disease Center, Carville, LA.
S. G. Franzblau, D. R. Jimenez, and N. A. Sinclair.
Journal of Environmental Science and Health JESEDU, Vol. A20, No. 5, p 583-591, July 1985. 4 tab, 11 ref.

Descriptors: *Flavobacterium, *Culture Media, *Potable Water, Drinking Water, Well Water.

A selective medium was developed for the primary isolation of opportunistic flavobacteria from potable water. A minimal-salts maltose yeast extract agar medium (MSMY) supplemented with either kanamycin (MSMY-K) or tobramycin (MSMY-T) was effective in suppressing the background microflora from most sources while allowing for the growth of Flavobacterium meningosepticum and Flavobacterium IIb. For routine sampling of well and distribution system water, 100 ml samples were filtered and filters placed on MSMY-K. F. meningosepticum and F. IIb were differentiated by the yellow pigment produced by the latter when incubated at 35 C on trypticase say agar. Opportunistic flavobacteria were isolated from 11/37 potable well and 5/50 potable distribution water samples tested using MSMY-K. MSMY-K may be of value in a membrane filtration procedure for testing large volumes of water for the presence of these infectious agents. (Peters-PTT)
W86-04239

EFFECTS OF METALS ON LEGIONELLA PNEUMOPHILA GROWTH IN DRINKING WATER PLUMBING SYSTEMS,
Pittsburgh Dept. of Water, PA.
S. J. States, L. F. Conley, M. Ceraso, T. E. Stephenson, and R. S. Wolford.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 5, p 1149-1154, Nov. 1985. 2 fig, 3 tab, 42 ref. EPA CR 80681-01-2.

Descriptors: *Drinking Water, *Legionella Bacteria, *Plumbing, Bacterial Analysis, Chemical Analysis, Metals, Corrosion, Iron, Zinc, Potassium, Hospitals, Storage Tanks, Water Tanks.

The chemical environment and growth of Legionella pneumophila in plumbing systems was investigated to gain a better understanding of its ecology in this habitat. Water samples were collected from hospital and institutional hot-water tanks known to have supported L. pneumophila and were analyzed for 23 chemical parameters. The chemical environment of these tanks varied extensively, with the concentrations of certain metals reaching relatively high levels due to corrosion. The effect of various chemical conditions on L. pneumophila growth was examined by observing its multiplication in a series of tap water samples artificially supplemented with various concentrations of metals. Additionally, growth of L. pneumophila was examined in a more natural setting by monitoring its multiplication in the chemically analyzed hot-water tank samples after sterilization and reinoculation with L. pneumophila obtained from a hot-water tank. These strains were maintained in tap water and had never been passaged in agar. The results of the growth studies indicate that although elevated concentrations of a number of metals are toxic, lower levels of certain metals such as iron, zinc, and potassium enhance growth of naturally occurring L. pneumophila. Parallel observations on accompanying non-Legionellaceae bacteria failed to show the same relationship. These findings suggest that metal plumbing components and associated corrosion products are important factors in the survival and growth of L. pneumophila in plumbing systems and may also be important in related habitats such as cooling towers and air-conditioning systems. (Author's abstract)
W86-04251

USE OF IMMUNOFLUORESCENCE AND PHASE-CONTRAST MICROSCOPY FOR DETECTION AND IDENTIFICATION OF GIARDIA CYSTS IN WATER SAMPLES,
Health Effects Research Lab., Cincinnati, OH.
For primary bibliographic entry see Field 5A.
W86-04255

EVALUATION OF METHODS FOR CONCENTRATING HEPATITIS A VIRUS FROM DRINKING WATER,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5A.
W86-04256

POTENTIAL HEALTH IMPLICATIONS FOR ACID PRECIPITATION, CORROSION, AND METALS CONTAMINATION OF DRINKING WATER,
Pennsylvania State Univ., University Park. School of Forest Resources.
For primary bibliographic entry see Field 5C.
W86-04264

COOPERATIVE SERVICE ARRANGEMENTS,
Department of Commerce, Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04283

ON-LINE PARTICLE COUNTING IMPROVES FILTER EFFICIENCY,
Johnson Controls, Inc., Carrollton, TX. Systems Engineering and Construction Div.
C. W. Hutchinson.
Water Engineering and Management, Vol. 132, No. 7, p 20, 22, 24-25, July 1985. 4 fig, 5 ref.

Descriptors: *Filtration, *Suspended solids, *Water treatment, *Particulate matter, *Process control, *Computers, Optimization, Coagulants, Chemical treatment, Automation, Filters, Cost analysis.

During the recent expansion of the Southern Nevada Water System, a distributed process control system was added to provide full automated control and process optimization. An innovative feature of this system is the use of on-line particle counting for monitoring and control of filtration. The particle counter was adopted after its use was demonstrated in laboratory tests to reduce chemical costs by 30%. In addition to providing optimum coagulant dosage determinations, the approach also contributes to savings in the form of reduced backwash frequency and associated load reductions on the sludge handling system. The particle counter is based on light blockage. Each particle in the water to be treated interrupts a beam of light directed onto a photosensitive detector. Particle size is determined by the amount of light blockage that occurs as each particle passes through the calibrated sensor. Since the orifice of the counter is susceptible to clogging, pre-filtering and an automatic backflush function are provided. A parallel computer interface provides a means for communicating data from the particle counter to the remote transmitting unit. Data from the counter can help plant operators detect filter breakthrough up to several hours in advance of actual occurrence. (Geiger-PTT)
W86-04285

TEXAS BOOMTOWN GETS NEW GUSHER,
R. C. Burrows, S. A. Webb, and D. Storm.
Water Engineering and Management, Vol. 32, No. 7, p 26-28, July 1985.

Descriptors: *Water treatment facilities, *Clarification, *Clarifiers, Automation, Chemical treatment, Turbidity, Color, Process control, Water treatment, Flocculation, Filtration.

To accommodate an increasing population, the Beaumont, Texas water treatment plant was expanded to meet water needs to the year 2000. A system was adopted which could use existing equipment and plant configuration, but not without a complete clarification system overhaul. The Pulsator clarifier manufactured by Infilco Degremont, Inc. was selected which is based on a hydraulic pulsation sludge blanket and could combine solids

contact mixing, flocculation, and solids/water separation, and continuous removal of sludge in a single process. After startup of the plant with the new clarifier, it was found that the unit could easily handle flow rate variations and raw water quality changes, while requiring little operator assistance. The Pulsator installation was complemented with improved filtration, chemical feed, and instrument systems. A liquid chemical feed system consisting of bulk liquid storage tanks, day tanks, and metering pumps was recommended and installed. Liquid alum replaced dry alum, lime which was being used for pH adjustment was replaced with liquid caustic soda, and liquid hydrofluosilicic acid replaced dry sodium silicofluoride. An advanced electronically controlled filter was installed, and hydraulic valves and mechanical flow rate valves were replaced by electrically motorized valves and electronic filter control tables. An evaluation of the chemical feed systwem is currently underway. These improvements at the North facility which allow the plant to achieve a capacity of 30 mgd will eliminate the South plant and free the land for future expansion needs. (Geiger-PTT)
W86-04286

ADVANCED TECHNOLOGY MAKES MOUNTAIN RUN-OFF PALATABLE,
W. Powell.
Water Engineering and Management, Vol. 132, No. 7, p 30-31, July 1985.

Descriptors: *Water treatment facilities, *Water treatment, *Clarifiers, *Filtration, *Turbidity, Filters, Clarification, Coagulation, Cost Analysis, Disinfection.

At Eagle, Colorado, a package water treatment system was recently installed that can efficiently handle the high turbidity levels that occur during the spring and summer due to mountain runoff. The new Culligan MT-108 Multi-Tech water treatment system consists of three trains of two tanks each. Each two-tank train comprises a depth clarifier and a depth filter connected in series so that water flows first through the clarifier and then the filter. The depth clarifiers make the system compact and efficient. Each contains a 40-in.-deep bed of contact clarifier mineral. The process uses alum and polymer as flocculants and coagulants, both stored in holding tanks and fed automatically. The depth filter contains three layers of filtering media, an arrangement that elimiates clogging. As water leaves the depth filter, it is gas chlorinated for basic disinfection and piped to an underground clearwell. From the clearwells it is distributed to three storage tanks. An efficient backwash sequence was provided in the design and installation of the facility. The new plant has proved to be substantially more economical to operate than the old one. (Geiger-PTT)
W86-04287

STABILIZING WATER WITH CHEMICAL DOSES,
Army Engineer Waterways Experiment Station, Vicksburg, MS.
T. M. Walski, J. M. Morgan, and M. W. Corey.
Water Engineering and Management, Vol. 132, No. 11, p 36-37, October 1985. 2 fig, 4 ref.

Descriptors: *Hydrogen ion concentration, *Water treatment, *Chemical treatment, *Computers, *Mathematical studies, *Lime, Alkalinity, Water treatment, Drinking water, Calcium carbonate, Stability analysis, Corrosion control, Water distribution.

Producing the best possible water for customers requires not only disinfection, but also a product with a pH that will not corrode distribution equipment. Trial-and-error methods of calculating the proper lime dosage to raise the pH of water are often very time consuming. A set of nomograms were developed for calculating chemical doses of calcium carbonate for all types of naturally occurring drinking waters. The nomograms were combined with a microcomputer to calculate the optimum chemical dose needed to stabilize water. The programs not only can calculate the chemical dose in terms of pure chemical, but given data on chemical purity and actual plant flow rate, they calculate feed rate in terms of pounds per hour of chemical. The combined microcomputer-nomogram system will be useful in correcting chemical dosing in response to pH changes due to temperature, variable water sources, and weather conditions. (Geiger-PTT)
W86-04295

MOTOR CONTROL ELIMINATES ERRATIC DISTRIBUTION PRESSURE,
El Reno City Public Works, OK.
G. Watts.
Water Engineering and Management, Vol. 132, No. 11, p 38, 40, October 1985.

Descriptors: *Pumps, *Water pressure, *Water distribution, Electrical equipment, Hydraulic equipment, Hydraulic machinery, Cost analysis.

A variable-speed motor drive was installed on a booster pump already in place on a water distribution pump of an Okiahoma town due to complaints of erratic water pressure. The drive was supplied by Parametric of Barry Wright. An isolated signal interface controller and existing pressure transducer located on the pump line is used to sense pressure. The transducer generates a feedback signal depending on line pressure. When low pressure is sensed, a signal instructs the motor drive to speed up the pump motor to increase the line pressure. As pressure increases, the motor slows to maintain an optimum value. A magnetic bypass system allows the pump to run at full speed in case of a motor drive failure. The new system has corrected the water pressure problems and is expected to increase the motor and pump life up to five times. Also in the flat pressure system, leaks and other problems are more easily detected, a factor which should also help reduce maintenance costs. (Geiger-PTT)
W86-04296

CHEMICAL BID PACKAGE CUTS COSTS, IMPROVES CONTROL,
Manatee County Water Treatment Plant, Bradenton, FL.
For primary bibliographic entry see Field 5D.
W86-04301

PREDOMINANT BACTERIAL GENERA IN GRANULAR ACTIVATED CARBON WATER TREATMENT SYSTEMS,
Philadelphia Water Dept., PA.
G. A. Burlingame, I. H. Suffet, and W. O. Pipes.
Canadian Journal of Microbiology CJMIAZ, Vol. 32, No. 3, p 226-230, March 1986. 4 tab, 21 ref. EPA Grant 806256-02.

Descriptors: *Granular activated carbon, *Bacterial analysis, *Drinking water, *Sand filters, *Chlorination, *Ozonation, Water treatment, Heterotrophic plate count techniques, Philadelphia, Pennsylvania, Pilot plants.

Granular activated carbon (GAC) beds may be used for removal of dissolved organic matter during the treatment of drinking water. However, they also might change the microbiological quality of the water entering the distribution system, either by changing the predominant bacteria or the bacterial density of the treated water. A 3-yr pilot plant study of water treatment using GAC beds was conducted at the Baxter Water Treatment Plant in Philadelphia. During the study, bacteria were isolated from raw water and from the effluents of the GAC treatment units. Bacteria genera in the GAC effluents and in the GAC units themselves were similar to those found in the raw water and in the sand beds. Prechlorination and (or) preozonation of the water before GAC treatment had no noticeable effect on the bacterial genera found as compared with a GAC unit having no predisinfection. The bacterial genera found in this study were similar to those found in seven other studies of GAC water treatment that used a variety of treatment schemes and a variety of heterotrophic plate count techniques to evaluate bacterial populations. From these several studies it appears that GAC treatment does not change the nature of the bacterial populations associated with drinking water. (Author's Abstract)
W86-04339

CHLOROFORM IN TAP WATER AND HUMAN BLOOD,
Turku Univ. (Finland). Dept. of Public Health.
R. Kroneld.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 477-483, April 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Drinking water, *Blood, *Chloroform, *Volatile halocarbons, Turku, Finland, Tap water, Well water.

Volatile halocarbons were sought in blood samples from the following three groups: patients in Turku, Finland, hospital and healthy subjects, both of which drank chlorinated water, and control subjects from the southwestern Finnish archipelago, who drank unchlorinated water from wells. Of the volatile halocarbons, only chloroform was found in blood samples from healthy individuals (about 4% of 200 samples) and patients(about 3% of 210 samples). Neither the blood of control subjects nor the water from the wells contaiined detectable amounts of chloroform. The fact that chloroform was not found in blood sugar samples in autumn, at the time when chloroform concentrations were highest in the water samples, suggests that blood chloroform may have come from sources other than water. When volatile hydrocarbons were added to blood samples, they were taken up significantly more by the cell fraction. (Rochester-PTT)
W86-04361

AQUATIC TOXICITY EVALUATED USING HUMAN AND MONKEY CELL CULTURE ASSAYS,
Shimane Prefectural Inst. of Public Health and Environmental Science, Matsue (Japan).
For primary bibliographic entry see Field 5C.
W86-04362

FLAVOR PROFILE ANALYSIS: TASTE AND ODOR CONTROL OF THE FUTURE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
J. H. M. Bartels, G. A. Burlingame, and I. H. Suffet.
American Water Works Association JAWWA5, Vol. 78, No. 3, p 50-55, March 1986. 2 tab, 51 ref.

Descriptors: *Taste, *Odors, *Organoleptic properties, *Drinking water, *Flavor profile analysis, *Taste panels, Water treatment, Sensory analysis, Water quality standards.

A standard method is needed in the drinking water industry to describe the actual flavor and aroma of a water sample in a qualitative and reproducible way, and to provide a quantitative estimate of the intensities of organoleptic (taste and odor) sensations. Organoleptic problems in drinking water and characteristics of sensory analysis are reviewed, and the employment of flavor profile analysis (FPA) as the method of choice for taste and odor description of water is described. Selecting and training FPA panelists, FPA methodology for the evaluation of drinking water, and goals for standardizing the FPA method are discussed. The FPA method used so far by water utilities has allowed panelists to use a large number of descriptives for characterizing water samples, but several descriptives seem to be used for the same sensation, making comparison among panel results difficult. The number of descriptives could be reduced by using standards for certain aromas and flavors. New panelists could be trained to recognize the aroma of a standard compound and to use a predesignated descriptive, even if their own sensation differs slightly. This approach might lead to a more universal vocabulary for description of water samples. (Rochester-PTT)
W86-04370

CASE STUDY OF GEOSMIN IN PHILADELPHIA'S WATER,
Philadelphia Water Dept., PA.
G. A. Burlingame, R. M. Dann, and G. L. Brock.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 56-61, March 1986. 4 fig, 2 tab, 20 ref.

Descriptors: *Algae, *Odor control, *Geosmin, *Philadelphia, *Hydraulic strategies, Activated carbon, Taste, Odor, *Water treatment, Schuylkill River, Pennsylvania.

Two episodes of unacceptable tastes and odors, which corresponded with levels of geosmin in the water that were much higher than the background level of 20 nanogram/liter or less, occurred in Philadelphia during 1985. The source of one episode was found to be a localized bed of algae in the Schuylkill River. An existing taste- and odor-control program, which utilizes instrumental and sensory analyses, was largely responsible for the effective management of the episodes. Hydraulic strategies were used to reduce the treatment plant's intake of geosmin, and powdered activated carbon in the treatment train further reduced the geosmin level. Dilution of this treated water with other finished waters in the distribution system also diminished the impact of geosmin on the taste and odor of Philadelphia's water. (Author's abstract)
W86-04371

OXIDATION OF FIVE EARTHY-MUSTY TASTE AND ODOR COMPOUNDS,
University of Southern California, Los Angeles. Dept. of Civil Engineering.
S. Lalezary, M. Pirbazari, and M. J. McGuire.
American Water Works Association JAWWA5, Vol. 78, No. 3, p62-69, March 1986. 7 fig, 3 tab, 60 ref.

Descriptors: *Geosmin, *Odor, *Chlorine, *Chlorine dioxide, *Ozone, *Permanganate adsorption, *Water treatment, Oxidation, Taste.

Four commonly used techniques (chlorination with C12, Chlorination with C102, and potassium permanganate adsorption) were tested for their effectiveness in removing five different organic taste and odor compounds from water. The compounds treated were geosmin, 2,3,6-trichloroanisole (TCA), 2-isopropyl-3-methoxy pyrazine (IPMP), 2-isobutyl-3-methoxy pyrazine (IBMP), and 2-methyl-isoborneol (MIB). Although testing was originally intended to simulate water treatment conditions, it was necessary to choose conditions that were often extreme, such as wide ranges of dosages and contact times, so that more conclusive evidence of the efficiencies of these techniques could be obtained. A comparison at equivalent dosages showed that chlorine dioxide was the most effective oxidant for removing the five selected compounds. (Rochester-PTT)
W86-04372

CHEMISTRY AND PHYSIOLOGY OF ODOR SENSITIVITY,
Agricultural Research Service, Albany, CA. Western Regional Research Center
J. E. Amoore.
American Water Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 70-76, March 1986. 6 fig, 3 tab, 12 ref.

Descriptors: *Olifactory sensitivity, *Specific anosmia, *Odor classification, Odors, *Drinking water, Geosmin, 2-Methylisoborneol, Organic compounds.

The chemistry and physiology of odor sensitivity are discussed, including individual human odor thresholds, the concept of primary odors, classification of odors, descriptives of odor problems in water, and tastes and odors of organics in water. The normal small sensitivities of healthy people, olfactometric properties of primary odorants, general odor classifications, specific anosmia ('smell-blindness') analyses, structural formulas of primary odorants, and structural formulas and olfactory properties of earth-musty odorants are considered. Odor threshold testing has demonstrated the wide variation in normal olfactory sensitivities of a population and the common occurrence of the specific anosmia. Continuing research on specific anosmia is leading to a fundamental classification of primary odors. Many objectionable primary odorants are composed of unsaturated or nucleophilic molecules and are susceptible to destruction, or conversion to odorless derivatives, by oxidizing agents added to the water. Odorants that resist oxidation, such as geosmin and 2-methylisoborneol, are a problem. (Rochester-PTT)
W86-04373

EARLY WARNING SYSTEM FOR TASTE AND ODOR CONTROL,
Southern California Metropolitan Water District, La Verne.
E. G. Means, III, and M. J. McGuire.
American Water Works Association JAWWA5, Vol. 78, No. 3, p 77-83, March 1986. 8 fig, 1 tab, 19 ref.

Descriptors: *Taste, *Odor, *Reservoirs, *Copper sulfate, Oscillatoria species, 2-Methylisoborneol, Geosmin, Algae, California, Lake Mathews.

An early warning system was set up that would detect impending taste and odor problems in Lake Mathews, a Southern California storage reservoir, and control was effected by identifying the sources of the earthy-musty odors, identifying the agents responsible, studying agents' habitat and distribution in the reservoir, and exploring various control methods. Advance notice has been provided effectively by sampling the reservoir at seven locations, with detection of 2-methylisoborneol and geosmin in the water. With this system, the severity and extent of annual taste and odor episodes has been minimized. Application of chunk copper sulfate has proven to be the most economical method of controlling the algae (Oscillatoria curviceps, O. splendida) responsible for the taste and odor problems. Long-term control options include addition of activated carbon (which is under investigation), biological controls, e.g., introduction of fish species that feed on blue-green algae, and construction of a bypass pipeline. (Rochester-PTT)
W86-04374

CHLORINE DIOXIDE FOR TASTE AND ODOR CONTROL,
Edmonton Water and Sanitation (Alberta). Water Treatment Section.
G. S. Walker, E. P. Lee, and E. M. Aieta.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 84-93, March 1986. 6 fig, 5 tab, 20 ref.

Descriptors: *Taste, *Odor, *Hydrocarbons, *Urban runoff, Activated Carbon, Water treatment, Canada.

A Canadian utility's experience with chlorine dioxide treatment for the prevention of tastes and odors is outlined. After 3 yr experience with high-yield C102 treatment for the control of taste and odor at Edmonton treatment plants, nearly all types of taste and odor complaints have been eliminated, the exception being those resulting from incomplete removal of street-runoff hydrocarbons that enter the river between the two treatment plant sites. Application of particulate activated carbon (PAC) is effective in removing hydrocarbons, but judging from the inability of these processes to eliminate complaints entirely, it is concluded that (1) the hydrocarbon molecule is refractory to C102 oxidation under water treatment conditions and (2) PAC, applied as a slurry at the headworks, is not efficient enough to complete the removal of offensive contaminants. (Rochester-PTT)
W86-04375

RETURNING RECENTLY COVERED RESERVOIRS TO SERVICE: HEALTH AND AESTHETIC CONSIDERATIONS,
Southern California Metropolitan Water District, La Verne.
S. W. Krasner, and E. G. Means, III.
American Water Works Association Journal JAWWA5, Vol. 78, No. 3, p 94-100, March 1986. 8 fig, 3 tab, 18 ref.

Descriptors: *Reservoirs, *Xylenes, *Bacterial analysis, *Chlorine residual, Trace organics, Odors, Flavor, Covers, California, Monitoring.

Garvey and Orange County reservoirs in Southern California are described, and the process of covering these two reservoirs and susequently returning them to service is discussed. Elastomer covers were installed with xylene as a solvent during fabrication. When the reservoirs were refilled, monitoring of chlorine residual, bacteria, trace organics, and odor and taste was conducted to ensure suitability of the water for use. These two finished-water reservoirs were filled and monitored in such a way that xylenes leaching from their covers were diluted to a negligible concentration in the effluents. The bacteriological quality of the water remained high throughout the filling and returning to service of the reservoirs. The floating covers have dramatically improved the overall microbiological quality of the two reservoirs — a major objective of the installing the covers. While the reservoirs were being restored to service, no complaints about the aesthetic quality of the water were received, and health requirements were satisfied. (Rochester-PTT)
W86-04376

OIL POLLUTION OF A GROUNDWATER SOURCE,
Eastbourne Waterworks Co. (England).
For primary bibliographic entry see Field 5B.
W86-04377

DESTRATIFICATION AT BEWL BRIDGE RESERVOIR, KENT,
Mid Kent Water Co., Canterbury (England).
For primary bibliographic entry see Field 5G.
W86-04378

DESIGN AND CONSTRUCTION OF NEW SPILLWAYS AND OTHER REMEDIAL WORKS TO THE LITTON RESERVOIRS, NEAR BRISTOL,
Watson Hawksley, London (England).
For primary bibliographic entry see Field 8A.
W86-04379

DIGITAL DISTRIBUTION SYSTEM RECORDS: A JOINT VENTURE,
North Surrey Water Co., Staines (England).
For primary bibliographic entry see Field 7C.
W86-04380

GRANULAR ACTIVATED CARBON AS SAND REPLACEMENT IN RAPID GRAVITY FILTERS,
Water Research Centre, Stevenage (England).
R. A. Hyde, D. G. Hill, and T. F. Zabel.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 40, No. 1, p 70-80, February 1986. 5 fig, 8 tab, 6 ref.

Descriptors: *Activated carbon, *Sand, *Sand filters, *Chlorination, *Bacteria, *Turbidity.

Work carried out at the Church Wilne water treatment works of the lower Trent division, Severn Trent Water (England), has shown that the few alterations are required to convert a sand filter to a granular activated carbon (GAC) filter. Exposed metal surfaces must be painted to prevent corrosion, provisions must be made for the removal of GAC, and backwash rates must be reduces by approximately 50% to avoid GAC losses. GAC of similar size to sand was as effective as the sand as a filter medium in terms of turbidity and residual coagulant removal. As expected, the GAC filter produced a water of lower organic content than the sand filter. However, the GAC dechlorinated the water and there were indications that the microbiological quality of the water from the GAC filter was worse than the water from the sand filter in which a free chlorine residual of 0.8 mg/l was maintained. The run lengths of the GAC filter

were, on average, 60 percent longer than those of the sand filter. At the same time effective carbon, sand replacement was less expensive than post-filter adsorbers as a means of applying GAC treatment. (Author's Abstract)
W86-04381

STUDY OF THE TRACE ORGANICS PROFILES OF RAW AND POTABLE WATER SYSTEMS,
Anglian Water Authority, Cambridge (England).
M. J. Pinchin.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 40, No. 1, p 81-99, February 1986. 13 fig, 7 tab, 6 ref.

Descriptors: *Gas liquid chromatography, *Trace organics, *Trihalomethanes, *Total organic carbon, *Raw water, *Potable water, Water treatment, England, Monitoring, Activated carbon, Carbon filters, Computers, Relative retention time, Great Ouse River.

Three water treatment works on the River Great Ouse, England, (Grafham, Bedford, Foxcote) and their distribution systems are described in terms of analyses of total organic carbon (TOC), trihalomethanes, and general organic quality determined by 'water profile analysis' based on gas-liquid chromatography (GLC) studies. The analytical technique used was designed to obtain information about a large number of GLC-amenable organics in a single run. This required the acceptance of unknown percentage recoveries during the solvent extraction, only relative quantification against a single internal standard, and limitation of the chromatographic conditions to give a reasonable overall performance within an acceptable time. Despite these restrictions, the system proved useful in the description of waters and treatment processes. When used on a comparative basis it has confirmed conclusions suggested by TOC measurements and has been readily interpretable in terms of storage and treatment. It is well suited to follow the performance of processes such as granular activated carbon filtration and to monitor sources that might be vulnerable to non-specific contamination, and for general survey work. Data analysis need not be restricted to broad relative retention time bands. The computer-based system can examine narrow sections of the profiles if required. (Rochester-PTT)
W86-04382

DESORPTION KINETICS OF PHENOL ON ACTIVATED CARBON,
California Univ., Davis. Dept. of Chemical Engineering.
C. Krebs, and J. M. Smith.
Chemical Engineering Science CESEAC, Vol. 40, No. 1, p 1041-1050, July 1985. 13 fig, 2 tab, 14 ref. NSF Grant 8026101.

Descriptors: *Kinetics, *Phenols, *Activated carbon, *Water treatment, Thermodynamics, Desorption, Activation energy, Mathematical studies.

Phenol absorbed on activated carbon from aqueous solutions is a complex system. When samples are thermally regenerated, the rate of desorption and the chemical species desorbed depend on the treatment prior to heating. It was found that only phenol is desorbed at temperatures in the range 110-200 C from samples prepared at 25 C and maintained in a desiccator at that temperature. Kinetics of desorption of such samples was studied by measuring weight and rate of weight change in runs at constant temperature (110-200 C) and at a constant heating rate (6 C/min). The data did not agree with first order kinetics using a constant energy, but could be explained by employing an exponential distribution of sites over a range of activation energies. Desorption was not complete even when samples were heated to 800 C. Our results and that of others indicate that the residue is most likely formed by reaction of phenol during the adsorption stage and during storage of the samples. (Author's abstract)
W86-04402

DECOMPOSITION OF OZONE IN WATER IN THE PRESENCE OF ORGANIC SOLUTES ACTING AS PROMOTERS AND INHIBITORS OF RADICAL CHAIN REACTIONS,
Eidgenoessische Anstalt fuer Wasserversorgung, Abwasserreinigung und Gewaesserschultz, Duebendorf (Switzerland).
For primary bibliographic entry see Field 5B.
W86-04428

TRANSFORMATION OF TRACE ORGANIC COMPOUNDS IN DRINKING WATER BY ENZYMATIC OXIDATIVE COUPLING,
Lyonnaise des Eaux, Le Pecq (France). Lab. Central.
S. W. Maloney, J. Manem, J. Mallevialle, and F. Fiessinger.
Environmental Science and Technology, Vol. 20, No. 3, p 249-253, March 1986. 4 fig, 2 tab, 21 ref.

Descriptors: *Organic compounds, *Trace levels, *Drinking water, *Enzymatic oxidative coupling, Enzymes, Water treatment, Horseradish peroxidase, Chlorinated phenols, Hydrogen peroxide.

A new method has been suggested for removal of aromatic compounds from water. The procedure involves enzymatic coupling of aromatic compounds and precipitation of the less soluble, high molecular weight end products. Horseradish peroxidase (HRP) catalyzes the oxidative coupling in the presence of hydrogen peroxide. This new method has been demonstrated on a laboratory scale with synthetic mixtures at concentrations (e.g., 100 mg/L) found in industrial wastewaters. These concentrations are quite high compared to drinking water, where the levels of specific organics lie in the nanograms per liter-micrograms per liter range. This paper examines HRP oxidative coupling of several chlorinated phenols. These compounds were chosen because they arise from a variety of anthropogenic sources, are often toxic, and present taste and odor problems in finished drinking water. Feasibility at low substrate concentration, interferences from natural background organics, and the nature of final products were investigated. The results indicate that enzymatic oxidative coupling using horseradish peroxidase and hydrogen peroxide may be useful in eliminating some aromatics that are not well-removed in biological or physical water treatment, but the nature of the byproducts must be determined to assure that the products are not more undesirable than the initial compounds. (Lantz-PTT)
W86-04439

DOES FLUORIDATION OF DRINKING-WATER PREVENT BONE FRAGILITY AND OSTEOPOROSIS,
National Board of Health, Helsinki (Finland).
O. Simonen, and O. Laitinen.
The Lancet LANCAO, Vol. II, No. 8462, p 432-433, August 24, 1985. 3 tab, 16 ref.

Descriptors: *Fluoridation, *Drinking water, *Osteoporosis, Bone fragility, Water treatment, Physiological effects, Kuopio, Jyvaskyla, Finland, Fluoride.

Bone fragility in elderly people is a serious public health problem, and the pressure on health services will increase as the proportion of elderly people rises. The effect of fluorides on bone tissue has been shown in several studies, and the use of fluorides for the treatment of osteoporosis and osteoporotic hip fractures has been recommended. The fluoridation of drinking water since 1945 has been successful in the prevention of dental caries in the general population and may possibly prevent bone fragility and osteoporosis. The aim of this study was to examine the association between incidence of femoral neck fractures in the population aged 50 and over, and fluoride content of 1 mg/l in drinking water. The incidence was compared in 2 Finnish towns of similar economic structure, Kuopio and Jvyaskyla. Kuopio has fluoridated its drinking water since 1959, while Jyvaskyla has only trace amounts of fluoride in its drinking water. The incidence of bone fragility (measured as femoral neck fractures) was found to be significantly less in Kuopio than in Jy askyla. This finding seems to be associated with a fluoride content of 1 mg/l in the drinking water of Kuopio. (Lantz-PTT)
W86-04453

DEVELOPMENT OF AN ON-LINE ZERO CHLORINE RESIDUAL MEASUREMENT AND CONTROL SYSTEM,
Metro Renton Treatment Plant, WA.
For primary bibliographic entry see Field 5D.
W86-04492

OPERATION AND MAINTENANCE OF THE UOSA WATER RECLAMATION PLANT,
CH2M/Hill, Reston, VA.
For primary bibliographic entry see Field 5D.
W86-04499

EFFECTS OF WATER REUSE, RECYCLING AND RESOURCE RECOVERY ON FOOD PROCESSING WASTE TREATMENT IN THAILAND,
Siametec International Ltd., Bangkok (Thailand).
For primary bibliographic entry see Field 5D.
W86-04513

ULTRAPURE WATER IN THE ELECTRONICS INDUSTRY,
Esmil International B.V., Amsterdam (Netherlands).
H. M. Bunnik.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 69-79, 1986. 4 fig.

Descriptors: *Ultrafiltration, *Electronic industry, *Industrial water, *Ultrapure water, Reverse osmosis, Cartridge filters, Pumps, Sand filters.

The production of integrated circuits needs an ultra pure water to prepare the acid cleaning and etching baths, to clean the matrices in order to stop the acidic action and to fill the cascade or overflow rinse tanks to remove the last traces of processing solutions. Etch, clean, flush and rinse steps are repeated many times for each matrix until the integrated circuit chip is ready. Impurities in the water can cause failures in the integrated circuit. The objective of this paper is to give an idea about the requirements for the ultra pure water used for the above mentioned applications and to describe an installation designed to meet these requirements - break tanks, sodium hypochlorite dosing, transfer pumps, sand filters, chemical dosing, cartridge filters, high pressure pumps, reverse osmosis units, etc. (Lantz-PTT)
W86-04518

USE OF OZONE IN THE TREATMENT OF WATER FOR POTABLE PURPOSES,
Singapore Public Utilities Board. Dept. of Water.
W. K. Wei.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 95-108, 1986. 5 fig, 4 tab, 5 ref.

Descriptors: *Ozonation, *Water treatment, *Potable water, *Water supply development, Rivers, Reservoirs, Estuaries, Storage reservoirs, Water supply, Water use, Cost analysis.

Singapore water supply comes from rivers, upland reseroivrs and estuarial reservoirs. There are seven estuarial reservoirs, all located in the western part of Singapore. The estuarial reservoirs were developed in the seventies and early eighties. They were formed by constructing dams or dykes across the river mouths or low lying coastal areas. Six out of the seven estuarial reservoirs collect the catchment runoff directly. The remaining one was built as an off-stream reservoir at the side of a canal with a top water level about 4 meters higher than the normal canal level. Hence water collected in the canal has to be pumped into this reservoir. It was necessary to develop the estuarial reservoirs in the seventies as all upland sources have been exploited. In taking this decision, it was necessary to commit a program to clean up the water catchments and strictly control the type of human activities and

degree of urbanization in the 'new' water catchments. Discussed here are the charcteristics of the various sources of raw water, various water treatment processes, characteristics of ozone and its usage in water treatment, types of ozonizers (plate-type and tub-type), the Chao Chu Kang ozone generation and treatment plant, problems experienced, and the costs of treatment. (Lantz-PTT)
W86-04520

CHANGES IN PARTICLE SIZE DISTRIBUTIONS ON A FIXED BED OF GRANULAR ACTIVATED CARBON,
New York State Dept. of Health, Albany. Div. of Labs. and Research.
E. A. Shpirt, and K. T. Alben.
Water Science and Technology WSTED4, Vol. 18, No. 1, p 31-42, 1986. 5 fig, 3 tab, 22 ref.

Descriptors: *Granular activated carbon, *Particle size, *Fixed bed, Water treatment facilities, Water treatment, Waterford, New York, Backwash, Calgon F400, Stratification, Domestic water.

The particle size distribution at different bed depths of a fixed bed of granular activated carbon (GAC) has been monitored during 50 weeks of a pilot column run at the Waterford, New York potable water treatment plant. Initial backwashing resulted in significant stratification of GAC in the column: larger particles (average diameter 1.18 mm) settled in the bottom of the colum (105 cm), and smaller particles (average diameter 0.97 mm) were concentrated near the top (24 cm), compared to samples of unstratified virgin Calgon F400 (average diameter 1.09 mm). During column loading and initial backwashing, more fines were created than were present in the virgin GAC (average 6.5% of GAC fines in the > 40 mesh fraction, compared to only 0.3% in the > 40 mesh fraction for virgin Calgon F400). After 50 weeks of service there was an overall trend toward a smaller average particle size (0.9 mm) with development of a more regular pattern of bed stratification (1.08 mm at the bottom and 0.75 mm at the top). These changes are attributed to breaking of large particles (12-20 mesh) and creation of intermediate size particles (20-30 and 30-40 mesh). (Author's abstract)
W86-04563

EXTERNAL MASS TRANSFER DURING THE ADSORPTION OF VARIOUS POLLUTANTS ONTO ACTIVATED CARBON,
Queen's Univ., Belfast (Northern Ireland). Dept. of Chemical Engineering.
For primary bibliographic entry see Field 5D.
W86-04572

ENHANCEMENT OF MERCURY (II) SORPTION FROM WATER BY COAL THROUGH CHEMICAL PRETREATMENT,
Sri Venkateswara Univ., Tirupati (India). Dept. of Civil Engineering.
For primary bibliographic entry see Field 5D.
W86-04574

PHOSPHATE ADSORPTION ONTO HYDROUS MANGANESE (IV) OXIDE IN THE PRESENCE OF DIVALENT CATIONS,
Shiga Univ., Otsu (Japan). Dept. of Chemistry.
M. Kawashima, Y. Tainaka, T. Hori, M. Koyama, and T. Takamatsu.
Water Research WATRAG, Vol. 20, No. 4, p 471-475, April 1986. 4 fig, 14 ref.

Descriptors: *Phosphates, *Adsorption, *Manganese oxide, *Cations, *Water treatment, Inorganic compounds, Barium, Calcium, Strontium, Magnesium, Natural waters.

Phosphate which exists as H2PO4(-) and HPO4(2-) in most freshwaters can be rapidly removed from solutions by adsorption onto inorganic substances. Hydrous Fe(III) oxide, hydrous Al oxide and clay minerals are thought to be important adsorbents for phosphate since all these substances have positive surface charges at slightly acid to neutral pH and therefore high affinities for anions. Alkaline earth cations, Ba(2+), Sr(2+), Ca(2+), Mg(2+) and transition metal ions, Mn(2+), Co(2+), Ni(2+), cause hydrous manganese (IV) oxide (HMO) to strongly adsorb phosphate between pH 6 and 9 depending on the cation. The effectiveness of the alkaline earth cations to cause P adsorption was Ba(2+) > Sr(2+) > Ca(2+) > Mg(2+), which is the same order as their affinities for the oxide. Changes with time were found in the abilities of the transition metals to cause P adsorption onto HMO and this may be due to conversion of the adsorbed cation to its oxide. A new potential role for HMO as an adsorbent of phosphate in natural waters was indicated. (Lantz-PTT)
W86-04577

SURVEY OF LEGIONELLA PNEUMOPHILA IN WATER IN 12 CANADIAN CITIES,
Health and Welfare Canada, Ottawa (Ontario). Health Protection Branch.
For primary bibliographic entry see Field 5A.
W86-04581

KINETICS OF METHANOGENS IN AN EXPANDED-BED REACTOR,
Illinois Univ. at Urbana-Champaign. Dept. of Civil Engineering.
Y.-T. Wang, M. T. Suidan, and B. E. Rittman.
Journal of Environmental Engineering JOEEDU, Vol. 112, No. 1, p 155-170, February 1986. 5 fig, 3 tab, 31 ref, append. EPA Contract No. EPA-809750-01.

Descriptors: *Mathematical models, *Biological treatment, *Biological membranes, *Kinetics, Anaerobic bacteria, Methane bacteria, Biomass, Mathematical studies, Model studies, Biological wastewater treatment, Substrates, Activated carbon, Anaerobic digestion, Monod kinetics.

A biofilm mathematical model for single-stage substrate utilization was developed for an expanded-bed, activated-carbon anaerobic reactor. The concepts of liquid-layer mass transport, biofilm molecular diffusion, and Monod kinetics were incorporated into the model. During 849 days of continuous operation, four steady state operating conditions were obtained, covering a wide range of feed acetate concentration. Steady state data collected when the feed acetate concentrations were 1,600 ml/L and 3,200 mg/L and weekly data obtained when the feed acetate concentration was 6,400 mg/L were used to estimate biokinetic parameters. The model input for each data set consisted of the acetate flux and the log-mean bulk acetate concentration within the reactor. The model was solved for attached biomass using each data set and various trial values of the two Monod constants (one for the half-velocity coefficient, the other for the maximum utilization rate of acetate), and a microbial biofilm density of methanogens. Best estimates of the two Monod constants and the biofilm cell density were obtained by observing the lowest value of the minimum sum of squared deviations between the model-predicted biomass and measured biomass. The biofilm kinetics were characterized as fully penetrated, with no significant external mass transport resistance. (Author's abstract)
W86-04587

TRY TACKLING A CORROSION INVESTIGATION,
Los Angeles City Dept. of Water and Power, CA.
For primary bibliographic entry see Field 8G.
W86-04619

PRECURSOR SIZE AND ORGANIC HALIDE FORMATION RATES IN RAW AND COAGULATED SURFACE WATERS,
Clarkson Univ., Potsdam, NY. Dept. of Biology.
R. L. Sinsabaugh, III, R. C. Hoehn, W. R. Knocke, and A. E. Linkins.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 139-153, February 1986. 4 fig, 8 tab, 46 ref.

Descriptors: *Organic carbon, *Halides, *Coagulation, *Sulfates, *Fulvic acids, Separation techniques, Surface water, Halogens, Particle size, Water treatment, Virginia, Trihalomethane.

The size distribution of organic carbon and organic halide precursors was determined for raw and coagulated waters from two Virginia reservoirs. Organic carbon removal by ferric sulfate coagulation was size dependent, with larger molecules (>5,000 daltons) removed more effectively than smaller ones (<1,000 daltons). In coagulated waters, the specific yields of organic halide and reaction rates of precursors with chlorine were low compared to the corresponding raw waters. These trends were explained by the selective removal of fulvic acids by coagulation. The dominant organic halide precursors in treated waters were small hydrophobic neutral molecules. Compared to fulvic acids, they had lower specific yields of organic halide and slower reaction rates with chlorine. Because this type of molecule was not removed by coagulation, their concentration ultimately determined whether coagulation alone was sufficient for trihalomethane control. (Author's abstract)
W86-04646

INACTIVATION OF NORWALK VIRUS IN DRINKING WATER BY CHLORINE,
Texas Univ. at San Antonio. Medical School.
B. H. Keswick, T. K. Satterwhite, P. C. Johnson, H. L. DuPont, and S. L. Secor.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 261-264, August 1985. 3 tab, 22 ref. EPA CR 810778-01-0, and PHS Grant RR00350.

Descriptors: *Norwalk virus, *Drinking water, *Chlorination, *Water Treatment, Viruses, Bacteriophage, Waterborne pathogens.

Norwalk virus in water was found to be more resistant to chlorine inactivation than poliovirus type 1 (LSc2Ab), human rotavirus (Wa), simian rotavirus (SA11), or f2 bacteriophage. A 3.75 mg/l dose of chlorine was found to be effective against other viruses but failed to inactivate Norwalk virus innoculum remained infectious for five of eight volunteers, despite the initial presence of free residual chlorine. Infectivity in volunteers was demonstrated by seroconversion to Norwalk virus. Fourteen of 16 subjects receiving untreated inoculum seroconverted to Norwalk virus. Illness was produced in four of the eight volunteers and in 11 of 16 control subjects. A similar Norwalk virus inoculum treated with a 10 mg/l dose of chlorine produced illness in only one and failed to induce seroconversion in any of eight volunteers. Free chlorine (5 to 6 mg/l) was measured in the reaction vessel after 30-minute contact period. Norwalk virus appears to be very resistant to chlorine which may explain its importance in outbreaks of waterborne disease. (Author's abstract)
W86-04670

CHANGES IN VIRULENCE OF WATERBORNE ENTEROPATHOGENS WITH CHLORINE INJURY,
Montana State Univ., Bozeman. Dept. of Microbiology.
M. W. LeChevallier, A. Singh, D. A. Schiemann, and G. A. McFeters.
Applied and Environmental Microbiology AEMIDF, Vol. 50, No. 2, p 412-419, August 1985. 7 fig, 1 tab, 35 ref. PHS Grant AI19089 and AM33510-01.

Descriptors: *Waterborne pathogens, *Chlorination, *Enteric pathogens, Yersinia enterocolitica, Salmonella typhimurium, Shigella, Escherichia coli, Coliforms, Water treatment.

Experiments to assess the effect of chlorine injury on the virulence of waterborne enteropathogens, were designed. Higher chlorine doses (0.9 to 1.5 mg/l) were necessary to produce injured Yersinia enterocolitica, Salmonella typhimurium, and Shigella spp. than to produce injured enterotoxigenic Escherichia coli or coliform bacteria (0.25 to 0.5 mg/l) in the test system used. 50% lethal dose experiments, in which mice were used, showed that injured Y. enterocolitica cells were 20 times less virulent than uninjured control cells (3,300 and 160 CFU, respectively). This decrease in virulence was not related to reduced attachment to Henle

407 intestinal epithelial cells, but could be related to a loss of HeLa cell invasiveness. In contrast, injured S. typhimurium and enterotoxigenic E. coli cells lost their ability to attach to Henle cells. These data show that some enteropathogens and coliform bacteria differ in their sensitivities to chlorine injury and that the virulence determinants affected by chlorine may vary from one pathogen to another. (Lantz-PTT)
W86-04673

5G. Water Quality Control

SAN JOSE DEL CABO, BAJA CALIFORNIA, NARROW VALLEY AQUIFER,
Universidad Nacional Autonoma de Mexico, Mexico City.
For primary bibliographic entry see Field 2F.
W86-03979

PROCEEDINGS: 1981 OIL SPILL CONFERENCE (PREVENTION, BEHAVIOR, CONTROL, CLEANUP).
American Petroleum Inst., Washington, DC.
February 28-March 3, 1983, San Antonio, Texas. 586 p.

Descriptors: *Oil spills, *Cleanup operations, *Conferences, *Dispersants, Environmental effects, Cold regions, Model studies, Case histories, Oil recovery, Brackish water, Natural waters, Oil, Oily water, Legal aspects, Oil pollution.

The biennial Oil Spill Conference Proceedings have been recognized worldwide as the authority for state-of-the-art information on oil spill equipment, regulation, and cleanup techniques, as well as the impacts resulting from social and legal forces. This 1981 Oil Spill Conference Proceedings presents a distinguished, international exchange of information with session sections covering topics such as: dispersants, laboratory and effluent water studies, training, modeling, cold water studies, case histories, petroleum in fresh and brackish waters, nearshore sediment studies, socioeconomic and legal aspects, offshore platform studies, and contingency planning. (Lantz - PTT)
W86-04001

DISPERSANT USE GUIDELINES FOR FEDERAL REGIONS IX AND X,
Fish and Wildlife Service, Sacramento, CA.
R. W. Smith, and R. Pavia.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 3-7, 12 ref.

Descriptors: *Dispersants, *Guidelines, *Oil spills, *Cleanup operations, Cleanup, Environmental contamination, Oil spill impact, Recommendations, Surfactants.

The Regional Response Teams in California, Oregon, and Washington have attempted to deal with the problem of providing rapid approval or denial of dispersant use requests during a major spill event. Realizing that the On-Scene Coordinator must act quickly in order for the dispersants to be effective, the RRT undertook a program to develop a system that would allow for approval or denial within four hours. The Regional Response Teams in Standard Federal Regions IX and X developed and implemented Dispersant Use Guidelines, from 1978 to the present, to enhance the regions' capability to respond rapidly to requests for approval of dispersant use. The physical, chemical, and biological parameters associated with spilled oil and dispersants are evaluated in this procedure. A decision to use dispersants is based on balancing the possible contamination of the environment with other factors. Damages expected from spills not treated with dispersants are compared to damages which would be expected if the oil were successfully treated. The objective is to minimize the impact of spilled oil on natural resources. This paper summarizes the progress of two Regional Response teams in responding to the questions of dispersant use, reviewing dispersant guidelines, and recommending minimum standards for documentation. The procedure involves the interaction and cooperation of the several agencies, and promotes the timely use of knowledge and information. (Author's abstract)
W86-04002

DISPERSION OF CHEMICALLY TREATED CRUDE OIL IN NORWEGIAN OFFSHORE WATERS,
Sentralinstitutt for Industriell Forskning, Oslo (Norway).
R. G. Lichtentaler, and P. S. Daling.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 7-14, 6 fig, 11 tab, 9 ref.

Descriptors: *Dispersants, *Oil spills, *Cleanup operations, *Oil slicks, *Water analysis, Cleanup, Oil, Chemical analysis, Gas chromatography, Surfactants.

In May and July 1982, two series of dispersant research oil spills were carried out off the Norwegian coast. The May series comprised three discharges of 2,000 liters of Statfjord topped crude oil (initial boiling point 150 C). Two of the slicks were treated with dispersants (A and B) from a boat while the third untreated slick served as control. The July series comprised four discharges of 2,000 liters of Statfjord crude oil, with the application of three dispersants (A, B, and C), and one untreated slick as control. Water samples were collected from under the slicks and analyzed for total petroleum using a gas chromatographic technique. Chemical analyses showed six percent dispersion of the oil for dispersant A, and 17 percent for dispersant B in the May series. Effectiveness of dispersants in the July series was found to be 19 percent for dispersant A and 22 percent and 2 percent for dispersants B and C, respectively. Gas chromatographic analyses showed in several cases the presence of dispersants (up to two ppm) in water samples without the presence of petroleum at all. The highest oil contents found in water samples were 10 ppm at a one meter depth. The variations in the effectiveness of the three dispersants tested in the field were later confirmed in laboratory tests. (Author's abstract)
W86-04003

TESTING OF A PROTOTYPE WASTE OIL FLARING SYSTEM,
Seaward International, Inc., Falls Church, VA.
R. L. Beach, and W. T. Lewis.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 29-32, 5 fig, 2 ref.

Descriptors: *Oil, *Oil wastes, *Incineration, *Flaring, Prototype tests, Prototypes, Flare incineration, Weather conditions, Hazardous environment.

This paper describes a prototype flaring burner system developed for the U.S. Coast Guard. The system is capable of flaring 180 gallons per minute (gpm) of light oil or 90 gpm of oil with a viscosity of up to 1,600 centistokes (cs). Smokeless burning can be achieved in certain cases. The system is designed to be portable. The entire system can be broken down into modules and transported in a C-130 aircraft, and each module is light enough to be carried to a remote spill site by a Coast Guard helicopter. The system is self-erecting and capable of operating safely in hazardous environments and in cold weather conditions. The performance test program conducted on the completed prototype system also is described. These tests were successful, with the conclusion that the prototype could be used for operational flaring at this time. (Author's abstract)
W86-04005

EFFECTIVE LOW COST FIREPROOF BOOM,
Environmental Protection Service, Montreal (Quebec).
K. M. Meikle.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 39-42, 5 fig, 2 tab, 4 ref.

Descriptors: *Booms, *Fireproof booms, *Oil spill, *Design objectives, *Prototype testing, *Incineration, Costs, Effectiveness.

The design objectives for a fireproof floating oil containment barrier were developed, and a boom was designed, produced, and tested. At a cost comparable to that of conventional equipment of similar size, the boom is equally effective at retaining oil in a current, withstands exposure to burning oil, and can easily be restored for reuse if damaged by severe wave action or rough handling. (Author's abstract)
W86-04006

DEVELOPMENT AND TESTING OF A FIREPROOF BOOM,
Dome Petroleum Ltd., Calgary (Alberta).
I. A. Buist, W. M. Pistruzak, S. G. Potter, N. Vanderkooy, and I. R. McAllister.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 43-51, 14 fig, 1 tab, 13 ref.

Descriptors: *Fireproof booms, *Oil spills, *Prototype testing, *Incineration, Booms, Oil, Cleanup operations, Confinement.

In situ burning of crude oil on water can be an extremely effective oil spill countermeasure, particularly in remote offshore areas and on cold water where conventional countermeasures are limited. In order for in situ burning to be an efficient mitigative technique, the oil must be contained and thickened. A novel fireproof boom has been researched, developed, and tested that can: (1) survive, without damage, long term exposure to the heat generated by burning crude oil in situ; (2) contain burning crude oil in at least sea states up to three and at current speeds up to 0.4 m/s without loss of combustion intensity; (3) survive without damage for long periods at sea; and (4) withstand contact with small ice features. (Author's abstract)
W86-04007

OPERATIONAL CONSIDERATIONS FOR OPTIMUM DEPOSITION EFFICIENCY IN AERIAL APPLICATION OF DISPERSANTS,
Exxon Chemical Co., Houston, TX. Technology Div.
G. P. Lindbloom, and B. S. Cashion.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 53-60, 10 fig, 4 tab, 8 ref.

Descriptors: *Dispersants, *Oil spills, *Cleanup operations, *Aircraft, *Deposition, *Distribution, Cleanup, Oil, Surfactants, Particle size, Viscosity, Velocity.

The growing worldwide recognition of the value of aircraft for application of dispersants to marine oil spills has resulted in a number of tests and field trials, but they have developed new concerns regarding control of depositional efficiency. These are similar to those extensively studied by the agricultural aviation industry, and involve anything influencing placement of a calculated dosage on a given area with minimum variation or loss due to aircraft turbulence, drift, or other factors. Aerial application of dispersants differs from agricultural practice in the physical properties of the fluids sprayed, the dosage generally required, and operational factors such as altitude, speed, swath, and total area to be covered. Consideration of these may result in need for special mechanical designs or alterations in the spray system. The major requirement for depositional efficiency is the droplet size distribution, which is affected by at

least five factors. The most critical are nozzle diameter, viscosity of the fluid sprayed, and its exit velocity relative to the aircraft speed. These, together with pressure and pump rates, result in two shear regimes which are the ultimate controllers of droplet size. This report presents evidence for the above from mathematical model studies, laboratory windstream tests, and flight tests of both piston and turbo powdered aircraft. The data are used to propose a framework of requirements for optimal aerial dispersant application operations. (Author's abstract)
W86-04008

PERFORMANCE EVALUATION OF A NEW VERSATILE OIL SPILL DISPERSANT,
Exxon Chemical Co., Houston, TX. Technology Div.
K. W. Becker, and G. P. Lindbloom.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p. 61-64, 6 fig, 5 tab, 2 ref.

Descriptors: *Oil spills, *Dispersants, *Surfactants, *Evaluation, *Saline waters, *Aircraft, Oil, Salinity, Viscosity, Oil-water interfaces, Organic solvents.

Several oil spill dispersants available since 1975 have successfully dispersed spills of light to medium oils. However, they generally have performed poorly on heavily weathered oil, low gravity viscous oils, waxy crudes, 'chocolate mousse' emulsions, and any oil spilled in cold environments. Some also were not formulated for use on waters of low salinity. In many cases involving spills of low viscosity oils, the decision to use chemical treatment has been delayed until the oil is in a weathered state. Chemical treatment under any of these conditions requires that the active surfactants reach the oil/water interface with the aid of a penetrating hydrocarbon solvent. Such formulations lose effectiveness when diluted with water (as in boat spraying) and usually must be used undiluted at a high dosage. They also often are too low in viscosity and density to be sprayed efficiently by aircraft. This paper discusses the properties and performance of formulations which avoid the above oil viscosity and water salinity problems and offer, for the first time, opportunity for widespread chemical treatment of such spills by aerial spray from large aircraft. (Author's abstract)
W86-04009

EFFECTIVENESS, BEHAVIOR, AND TOXICITY OF DISPERSANTS,
Toronto Univ. (Ontario). Inst. for Environmental Studies.
For primary bibliographic entry see Field 5C.
W86-04010

SELF-CONTAINED OIL RECOVERY SYSTEM FOR USE IN PROTECTED WATERS,
Coast Guard, Washington, DC. Office of the Commandant.
S. Cohen, and S. Dalton.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 73-79, 9 fig.

Descriptors: *Oil spills, *Cleanup operations, *Oil recovery, *Storage, *Skimming, Oil, Booms, Containment boom, Barriers.

The U.S. Coast Guard's success with the high seas skimming barrier prompted the development of a smaller, half-scale version for use in protected bays and harbors. The smaller version (SCOOP) enables more rapid deployment with significantly fewer people. Individual components of the system include a 65-foot section of skimming barrier with redesigned skimming struts, 200 feet of containment boom, two 30-foot work boats for storage, transport, and operation of the system, trailers to carry the boats to the scene, and an oil recovery system including double-acting diaphragm pump, gravity-type oil-water separator, and 750 gallon collapsible storage bags. In tests at the Environmental Protection Agency's Oil and Hazardous Materials Simulated Test Tank (OHMSETT) facility, the SCOOP exhibited recovery efficiencies between 30 percent and 60 percent over a speed range of 0.5 to 1.75 knots. The oil recovery rate was between 30 and 70 gallons per minute over the same speed range. At speeds below 0.9 knots there were no losses of oil from the boom. The system has been delivered to the Coast Guard Gulf Strike Team in Bay St. Louis, Mississippi, where it is being evaluated through use in routine spill response operations and exercises. (Author's abstract)
W86-04011

OHMSETT TEST OF TRUCK-MOUNTED VACUUM SYSTEMS FOR OIL SPILL RECOVERY,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
D. C. Gates, K. M. Carradino, and W. R. Sanftner.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 81-85, 1 fig, 4 tab, 6 ref.

Descriptors: *Oil recovery, *Vacuum skimming, *Oil skimmers, Skimming, *Oil spills, Cleanup operations.

Two recent test programs at the U.S. Environmental Protection Agency's Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) examined two different vacuum systems. The first program, performed in September 1980, tested a vacuum truck fabricated by Coleman Environmental and Pollution Control Equipment Co., Inc. and a Vactor 2045 air conveyor system made by the Peabody Myers Company. The vacuum truck produced an average and an oil recovery efficiency of 18 percent. Results confirmed the prevalent belief that this type of equipment is well suited for use in thick slicks (i.e., above 60 millimeters). The addition of skimmer attachments to the hose end increased recovery efficiency without affecting oil recovery rate. The air conveyor tests resulted in an average oil recovery rate of 4.4 cu m/hour (19.4 gpm) and a recovery efficiency of 61 percent. The air conveyor worked well, particularly with thinner slicks. The independent variables incorporated into the first test program included slick thickness, test oil viscosity, blower speed, length of the recovery hose, the height of the suction hose end above the slick, and use of skimmer attachments. The second test program, performed in August 1982, extended the investigations of the initial program, adding a more viscous test oil, debris, and a different skimming attachment for the hose end. Also included were tests to confirm results of the first program. The truck used in the second program was another vacuum truck made by Coleman Environmental and Pollution Control Equipment Co., Inc. The standard vacuum truck yielded an average oil recovery rate of 5.0 cu m/hour (22 gpm) with an average oil recovery efficiency of 51 percent. This was over nine different phases, each phase studying the effect of a different combination of variables. Skimming a higher viscosity test oil in the range of 11.2 centipoise (cp) to 318 cp caused an increase in oil recovery rate and recovery efficiency. The addition of a skimming attachment increased recovery efficiency and decreased oil recovery rate. Tests with debris confirmed the necessity of keeping debris away from the hose end. (Author's abstract)
W86-04012

OHMSETT PUMP TESTS,
Mason and Hanger-Silas Mason Co., Inc., Leonardo, NJ.
M. Borst, R. J. Cocherell, and H. W. Lichte.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 87-94, 5 fig, 1 tab, 11 ref.

Descriptors: *Oil recovery, *Pumps, *Pump testing, *Oil spills, Cleanup operations.

Pumps are an integral part of all oil spill recovery operations. Skimmers and booms are of little or no practical use if the recovered spill cannot be transferred to permanent installations for further treatment, storage, or disposal. The recovered oil may be weathered, emulsified, debris-filled, or simply highly viscous. The U.S. Environmental Protection Agency has recognized the importance of this often over-simplified operation and performed tests at its Oil and Hazardous Materials Simulated Environmental Test Tank (OHMSETT) to document the performance of a variety of pumps commonly used at spills and pumps less commonly used for this specific purpose. The tests were designed to provide performance curves for each pump and to document the abilities of the pumps in four specific situations. While the same tests were applied to each pump to produce these performance curves, because of the different designs and inherent characteristics of each of the pumps (an internal and external gear, progressive cavity, centrifugal, and diaphragm type), comparisons were not intended and would be counterproductive. The results of the tests on each pump stand on their own merits. The first tests run with each pump were conducted to measure the suction-head and discharge-head abilities of each unit using clean oils. Four oils were chosen to cover a range of viscosities from less than 10 centipoise to several thousand centipoise depending on ambient conditions. The next set of tests documented the pumping characteristics when oil and water were introduced to the pump as non-mixed fluids for concurrent pumping and, more importantly, measured the tendency of the pump to emulsify the oil and water. The third set of tests measured the same relationship as the oil tests using pre-emulsified oil of a high apparent viscosity as a non-Newtonian test fluid. The fourth set of tests simply measured debris-handling abilities of the pump. This paper presents the initial results for the types of pumps chosen from the OHMSETT inventory. (Author's abstract)
W86-04013

RESEARCH AND DEVELOPMENT IN THE INSTITUTE OF OCEAN ENVIRONMENTAL TECHNOLOGY,
Japan Foundation for Shipbuilding Advancement, Tokyo. Inst. of Ocean Environmental Technology.
A. Yazaki.
In: Proceedings of the 1983 Oil Spill Conference (Prevention Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 95-103, 9 tab, 26 ref.

Descriptors: *Oil spills, *Booms, *Skimmers, *Chemical dispersants, Cleanup operations, Design objectives.

This paper presents a summary of research and development projects at the Institute of Ocean Environmental Technology. First, projects in the field of oil boom and skimmer development are described. Oil containment performance for each of four new oil booms, and the oil recovery rate for each of seven new oil recovery devices and a new oil recovery ship are explained. Next, as typical examples of research projects concerning ocean and marine environmental problems, summaries of the following themes are presented: (a) oil spreading on the water surface, (b) the mechanism of oil leakage from a flat plate barrier, (c) oil slick behavior around a moving catamaran skimmer, (d) a law of similarity for the performance of oil recovery equipment, (e) evaporation of gasoline under various conditions, (f) the relationship of spilled oil and dissolved oxygen in sea water, (g) the effectiveness of chemical dispersants for spilled gasoline, (h) the generation of transient waves in a circulating water channel, and (i) experiments with a wave energy absorber. (Author's abstract)
W86-04014

ENHANCED OIL BIODEGRADATION: A NEW OPERATIONAL TOOL TO CONTROL OIL SPILLS,
Elf Aquitaine, Pau (France).
B. Tramier, and C. Sirvins.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), Ameri-

can Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 115-119, 4 fig, 5 tab, 11 ref.

Descriptors: *Oil spills, *Biodegradation, *Cleanup operations, Oil pollution, Oil.

Biodegradation of oil is a natural and universal process. Unfortunately, it is a slow one, and most attempts to enhance it have failed. A new approach has been devised to try to render this enhancement process operational. A nutrient including nitrogen, phosphorus and carbon has been developed and formulated as an oleophilic microemulsion. It is, therefore, not dispersed in seawater. The nutrient has been tested in laboratory and field situations in temperate and cold climates. Biodegradation rates have ranged from 60 percent to 85 percent depending on conditions. Combined with natural evaporation, enhanced oil biodegradation can lead to a reduction in oil content of at least 65 percent in less than one week. (Author's abstract)
W86-04016

METHOD FOR RANKING BIOLOGICAL RESOURCES IN OIL SPILL RESPONSE PLANNING,
National Coastal Ecosystems Team, Slidell, LA.
For primary bibliographic entry see Field 6B.
W86-04017

ECOLOGICAL MAPPING AND CLEANUP OF OIL SPILLS ONSHORE,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
For primary bibliographic entry see Field 5B.
W86-04018

MIRG ENVIRONMENTAL ELEMENT: AN OIL SPILL RESPONSE PLANNING TOOL FOR THE GULF OF MEXICO,
ARCO Oil and Gas Co., Bakersfield, CA.
J. Lindstedt-Siva, B. J. Baca, and C. D. Getter.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas, p 175-181, 7 fig, 18 ref.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, Ecological effects, Mapping, Oil pollution, Oil, Gulf of Mexico.

Several companies involved in the marine transportation of petroleum in the Gulf of Mexico have established the Marine Industry Group (MIRG). MIRG has funded two oil spill contingency planning information projects for the Gulf of Mexico. The Resources and Logistics Element identifies the location and accessibility of cleanup equipment in the area of interest. The Environmental Element describes Gulf of Mexico environments, identifies biologically and socioeconomically sensitive areas, and includes countermeasure considerations. This paper examines the environmental element of the MIRG project. The purpose of this element is to provide environmental information on the Gulf of Mexico coastline in a form that can easily be used during an oil spill emergency. The information covers both U.S. and Mexican nearshore waters and coastal areas and is specific enough to provide meaningful guidance to spill response personnel. The environmental element is divided into two volumes. Volume I is an environmental overview of the Gulf of Mexico environments, an analysis of possible spill impacts, and spill cleanup considerations for each type of environment. Volume II is divided into regional sections. Each section includes overview maps of the area covered, detailed maps of identified sensitive areas, and accompanying data sheets which include reasons for sensitivity, access and possible launch points for equipment, and countermeasure considerations. These volumes are designed to function as field manuals during spills as well as reference documents for spill response planning. (Author's abstract)
W86-04019

OIL SPILL PROTECTION PLANNING FOR NATURAL RESOURCES IN OREGON,
Oregon State Dept. of Environmental Quality, Corvallis.
For primary bibliographic entry see Field 6A.
W86-04020

OIL SPILL PREPAREDNESS IN A TROPICAL OFFSHORE AREA,
Smith Associates Consulting System Engineers Ltd., Surrey (England).
For primary bibliographic entry see Field 6A.
W86-04021

OIL SPILL ON NORTHERN SHORELINES: AN EVALUATION OF SOME OPTIONS DEALING WITH THIS PROBLEM,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
E. Senstad, and P. Sveum.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 255-260, 10 fig, 6 tab, 16 ref.

Descriptors: *Oil spills, *Cleanup operations, *Oily water, *Shores, Coasts, Composting, Oil pollution, Oil.

Three options for dealing with oily debris from oil contaminated shorelines are studied. It is shown that bunker oil does not affect plant life but does kill the invertebrates in the contaminated supralittoral zone. A non-sticky soil surface can be established if treated with a sorbent. Oily debris picked up by hand, composted with sorbents, and conditioned with fertilizers showed a decrease in total oil content of approximately 60 percent after 400 days. The addition of sorbents gave approximately the same rate of biodegradation, whereas the addition of fertilizer alone had a less beneficial effect on oil biodegradation. The use of sorbents did not affect the generation of leachate water from the compost piles. The oil content in the leachate was between 20 and 40 milligrams per liter. Seaweed in the oily debris decomposed rapidly. The volume of piles was reduced by about 50 percent. Total oil content was approximately constant in the compost piles. The rapidly decomposing seaweed made it difficult to keep the compost piles in an aerobic state. Oily debris mixed with lime (CaO) produced a dry material. The lime volume required was approximately equal to the oil volume in the debris. Even after this treatment, some oil and other organic components were released with the leachate. The process of mixing lime into the oily debris was very unpleasant for the workers and posed a severe working environment problem. (Author's abstract)
W86-04022

SHORELINER EXPERIMENTS AND THE PERSISTENCE OF OIL ON ARCTIC BEACHES,
Woodward-Clyde Consultants, Victoria (British Columbia).
For primary bibliographic entry see Field 5B.
W86-04023

FIRST EXPERIENCES WITH THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY OIL SPILL MODEL,
Massachusetts Inst. of Tech., Cambridge.
H. N. Psaraftis, J. D. Nyhart, and D. A. Betts.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 301-305, 4 fig, 2 tab, 10 ref.

Descriptors: *Oil spills, *Modelling, *Cleanup operations, Planning, Dispersants, Environmental effects, Cost Analysis, Oil.

A research group at the Massachusetts Institute of Technology has completed the first phase of development of a computer-assisted model for analyzing complex decisions and policies regarding oil spill cleanup. The model is the product of an ongoing MIT Sea Grant project sponsored by a consortium of government and industry organizations. The model can be used, among other things, in 'strategic' planning for the long-term oil spill response needs of a region, in assisting on-scene coordinators in responding to a specific spill ('tactical operational' setting), in evaluating the environmental and economic damages of a spill versus the cost of cleanup, in simulation and training, and in the analysis of various policy and regulatory issues such as delays, use of dispersants, and liability and compensation. The model is described in detail, with a focus on its potential uses. Some illustrative applications in the New England region are presented and applications of the model for the solution of Petro-Canada's dispersant logistics problem are discussed briefly. (Author's abstract)
W86-04025

REVIEW OF THE STATE-OF-THE-ART OF OIL SPILL FATE/BEHAVIOR MODELS,
Raytheon Co., Portsmouth, RI. Submarine Signal Div.
J. C. Huang.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 313-322, 5 tab, 58 ref.

Descriptors: *Oil spills, *Fate of pollutants, *Modelling, *Cleanup operations, *Reviews, Environmental effects, Advection, Evaporation, Dispersants, Distribution patterns, Biodegradation.

The fate and behavior of spilled oil can be affected by nine physical, chemical, and biological processes: advection, spreading, evaporation, dissolution, emulsification, dispersion, auto-oxidation, bio-degradation, and sinking/sedimentation. Currently, oil fate predictions and/or the assessment of environmental impact or risk of a spill are based mostly on oil spill models which simulate only the advective processes and some which include also the spreading processes. These models do not account for the weathering or the loss of the spilled oil that may occur immediately or soon after the spill, and thus may lead to unrealistic assessments or inaccurate predictions. Models with varying degrees of sophistication and with different approaches for the various weathering processes are being developed, some of them implemented in composite oil fate/behavior models that are constructed to provide more realistic or accurate predictions. To provide some understanding of the current state-of-the-art of these modeling technologies, this paper presents an overview and discussion of the available models for each of the nine oil fate/behavior governing processes. (Author's abstract)
W86-04026

TEXACO CONNECTICUT'S OIL SPILL INCIDENT IN THE PANAMA CANAL,
Panama Canal Commission, APO Miami 34011.
C. V. Chong, J. C. Jordon, and R. Gutierrez.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 369-370.

Descriptors: *Oil spills, *Cleanup operations, *Environmental effects, Oil recovery, Case studies, Panama canal, Texaco Connecticut.

The second largest recorded oil spill to occur in the waters of the Panama Canal happened on June 7, 1980. The 39,366 deadweight ton (dwt) United States tanker Texaco Connecticut, while on a northbound transit and laden with Alaskan crude, struck the east bank of Gaillard Cut, ripping its number 1 and 2 cargo tanks. In a period of approximately six hours, from the time the tanker struck the bank of the canal until it was anchored for repairs at Limon Bay, the Atlantic entrance to the Panama Canal, an estimated 4,000 barrels (bbl) or crude were spilled in a distance of approximately 35 miles. A multi-agency effort was deployed immediately. The Panama Canal Commission's own pollution control forces, in close working coordination with other units of the commission, the United States Army and the Government of the Republic of Panama were able to recover a

total of 1,361 bbl of crude. Manual and mechanical methods of oil recovery were used during 27 days in which an estimated total of 29,396 man hours were used at a total cost of approximately $800,000. The environmental impact of the spill was observed by Panama Canal Commission biologists as well as by the Smithsonian Tropical Research Institute (STRI). Although no baseline data exists for comparison, it is apparent that no far reaching negative effects were imposed on the fauna and flora of Gatun Lake. (Author's abstract)
W86-04028

HASBAH 6: OIL COMPANIES RESPONSE TO OIL POLLUTION IN THE ARABIAN GULF,
Gulf Area Oil Companies Mutual Aid Organization, Manama (Bahrain).
For primary bibliographic entry see Field 6B.
W86-04029

HASBAH 6 (SAUDI ARABIA) BLOWOUT: THE EFFECTS OF AN INTERNATIONAL OIL SPILL AS EXPERIENCED IN QATAR,
Shell International Petroleum Mij., The Hague (Netherlands).
For primary bibliographic entry see Field 5C.
W86-04031

UNDERGOUND OIL SPILL INVESTIGATION AND CLEANUP,
Environmental Protection Agency, Boston, MA. Region I.
D. McIntyre.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 393-396, 7 fig, 3 ref.

Descriptors: *Oil spills, *Cleanup operations, *Underground waste disposal, *Leaching, Oil pollution, Oil recovery, Case studies, Oil.

In April 1978, the U.S. Environmental Protection Agency (EPA) Region I office received an oil spill report which involved a sheen leaching from an industrial park into a river in Connecticut. Initial investigation revealed only two 10,000-gallon and one 11,000-gallon buried storage tanks as possible sources. All were located relatively close together about 200 feet from the river. The maintenance man reported that one of the 10,000-gallon tanks had spilled an estimated 500 gallons into the ground the previous year. EPA responded and initially worked with the property owner and the Connecticut Department of Environmental Protection in addressing the problem. Although the leaching seemed to be relatively minor at first, it gradually increased after July 1978. The property owner was unable to finance cleanup actions after the first few months. EPA assumed cleanup responsibility, using federal funds, and eventually took over all investigation and recovery efforts in 1980. The incident has involved many phases, including locating and estimating the volume of the underground contamination, attempted source identification through sample analysis, installing recovery systems, excavating the oil storage tanks, winter operations of the recovery systems, disposal of product, and river cleanup. Analyses of test boring data in 1979 indicated the maximum volume of spilled product on the groundwater to be between 50,000 and 150,000 gallons. Since 1980, the recovery system alone have yielded more than 90,000 gallons of oil, making this innocuous incident one of the largest inland oil spills ever in Region I. It also has been the most expensive federally-funded inland spill in the region. Recovery from the groundwater is expected to continue through 1982, albeit at a decreasing rate. The total observed volume of oil involved in the spill will probably exceed 110,000 gallons. (Author's abstract)
W86-04032

GEOMORPHOLOGICAL IMPACT OF CLEAN-UP OF AN OILED SALT MARSH (ILE GRANDE, FRANCE),
Institut National de la Recherche Scientifique, Rimouski (Quebec).
For primary bibliographic entry see Field 5C.
W86-04039

GROUND WATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,
Robert S. Kerr Environmental Research Lab., Ada, OK.
C. W. Hall.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 3-5, 12 ref.

Descriptors: *Groundwater, *Water quality protection, *Water quality control, Environmental protection, Legislation, Public participation, Groundwater pollution.

The importance of protecting ground-water resources cannot be overstated, and many people throughout the world seem anxious to physically and financially support a rational program to this end. The complacency of the public regarding the quality of ground-water was destroyed with headline-grabbing incidents of pollution such as Love Canal, Valley of the Drums, and Times Beach. Contrary to earlier popular belief, the soil mantle has been shown to be ineffective in the cleansing of certain pollutants from the water flowing through it. The legislative basis for developing and implementing broad ground-water quality protection programs exists, although it is dispersed in a variety of pieces of legislation. Such programs presuppose the existence of the scientific knowledge necessary to produce viable and effective results from its implementation. This article addresses the research needed for accumulation of this scientific knowledge. (Author's abstract)
W86-04043

APPLICATION OF BIOLOGICAL TRANSFORMATIONS IN GROUND WATER,
Stanford Univ., CA. Dept. of Civil Engineering.
P. L. McCarty.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 6-11, 2 fig, 3 tab, 24 ref.

Descriptors: *Biotransformation, *Groundwater, *Groundwater pollution, Microorganisms, Biodegradation, Microbial degradation, Organic compounds, Substrates, Path of pollutants, Fate of pollutants.

Microorganisms can bring about the transformation of many common trace organic ground-water contaminants which serve as secondary substrates. Half-lives of such compounds are generally long because of low active microbial concentrations, inappropriate environmental conditions, or inability of indigenous bacteria to acclimate to the compounds. Some hazardous compounds such as chlorinated benzenes appear biodegradable only under aerobic conditions, while others such as many halogenated aliphatic compounds appear biodegradable only under anaerobic conditions. Biotransformation of some compounds, such as tetrachloroethylene, 1,1,1-trichloroethane, and ethylene dibromide, result in the transient formation of intermediates such as vinyl chloride. The impact of environmental conditions and intermediate formation needs to be better understood. Biotransformation rates might be increased through the stimulation of indigenous bacteria by injection of a suitable primary substrate and required nutrients, and by maintenance of a suitable environment. This might also result from the introduction of acclimated bacteria. However, much more needs to be known about the native microorganisms, their biochemical capabilities, and the effect of environmental conditions on biodegradation. (Author's abstract)
W86-04044

MICROBIAL ECOLOGY OF A HAZARDOUS WASTE DISPOSAL SITE: ENHANCEMENT OF BIODEGRADATION,
Rice Univ., Houston, TX. Dept. of Environmental Science and Engineering.
For primary bibliographic entry see Field 5D.
W86-04048

SORPTION OF ORGANIC SOLUTES: COMPARISON BETWEEN LABORATORY-ESTIMATED RETARDATION FACTORS AND FIELD OBSERVATIONS,
Stanford Univ., CA. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04051

REMOVAL OF IRON AND MANGANESE FROM GROUND WATER WITH THE VYREDOX METHOD,
Ground Water Associates, Inc., Arlington, MA.
A. W. Zienkiewicz.
IN: Second International Conference on Ground Water Quality Research: Proceedings, National Center for Ground Water Research, Houston, Texas. (1985). p 74-77, 5 fig, 3 tab, 4 ref.

Descriptors: *Iron, *Manganese, *Vyredox, Water quality control, Oxidation-reduction potential, Groundwater.

Water systems with wells drawing ground water containing soluble iron and manganese can have production capacity losses, transmission capacity losses and consumer complaints about odor, staining and taste. Vyredox is a method for removing iron and manganese from ground water at the source, in the ground, before the water is drawn to a well. It works by raising the redox potential in the ground around a well with periodic recharges of aerated water using specially engineered conditioning equipment and recharge wells. The oxygen in the recharge water acts as a catalyst to begin a biochemical reaction that transforms iron and manganese from their soluble form to insoluble compounds that are kept in the ground away from the well. Vyredox plants have been in operation world wide since 1955. Since 1979, in the U.S., pilot studies have been conducted at 20 sites. Full scale plants have been completed at three sites and are under construction at three more. Vyredox has proved applicable and economical in varied settings for a wide range of raw water quality. (Author's abstract)
W86-04061

APPLICATION OF MULTI-PHASE FLOW THEORY AT A CHEMICAL WASTE LANDFILL, NIAGARA FALLS, NEW YORK,
Little (Arthur D.), Inc., Cambridge, MA.
J. H. Guswa.
In: Second International Conference on Groundwater Quality Research: Processings, National Center for Groundwater Research, Houston, TX. (1985). p 108-111, 7 fig, 1 tab, 8 ref.

Descriptors: *Chemical wastes, *Multiphase flow, *Path of pollutants, *Landfills, *Waste pollution protection, *New York, Waste dumps, Simulation, Flow simulators, Fluid flow, Hydrogeology, Niagara Falls.

A one-dimensional two-phase fluid flow simulator was developed for Occidental Chemical Corporation to aid design of a remedial action plan for a chemical waste landfill in the Niagara Falls area, New York. A two-phase flow model was necessary because field observations have indicated that immiscible dense organic chemicals exist as a separate fluid phase in the landfill. Under these conditions the effects of capillary pressure forces as well as hydrodynamic and gravitational forces must be considered in order to predict fluid movement and to simulate the effects of various remedial actions. The two-phase fluid flow simulator was used to identify various hydrogeologic conditions which could be an effective barrier to the downward migration of a heavier-than-water non-aqueous phase liquid (NAPL) from unconsolidated glacial deposits to the underlying bedrock. Analysis of model results indicated that even under a downward hydraulic gradient natural differences in capillary pressure relationships for different lithologies could prevent downward migration of NAPL. It was also determined that in the absence of natural

lithologic barriers an upward hydraulic gradient created by an overburden dewatering system could also prevent downward migration of NAPL. (Author's abstract)
W86-04069

MODEL TO EVALUATE SALT WATER INTRUSION DUE TO DIFFERENT CONJUNCTIVE USE STRATEGIES IN COASTAL AQUIFERS IN SAUDI ARABIA,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
T. H. Illangasekare, and H. J. Morel-Seytoux.
In: Second International Conference on Groundwater Quality Research: Proceedings, National Center for Groundwater Research, Houston, TX. (1985). p 119-121, 1 fig, 7 ref.

Descriptors: *Saline water intrusion, *Modeling, *Coastal aquifers, Groundwater, Surface-groundwater relations, Numerical analysis, Surface water, Groundwater quality.

A study was conducted to evaluate different strategies of conjunctive use management of surface and groundwater in the coastal aquifers of the Red Sea coast in Saudi Arabia. A physically based distributed parameter model was developed to simulate both the physical behavior and the operational behavior of the surface-groundwater system. The numerical model developed was based on the 'Discrete Kernel Approach' of groundwater modeling (a response matrix model). The development strategies tested were designed to use the groundwater as a supplementary source to the traditionally used surface supplies. The excessive extraction of groundwater may result in the mining of the aquifer and degradation of groundwater quality by the intrusion of sea water. A component of the model simulates the salinity transport at the coastal boundary of the aquifer. This paper presents the design of this model component and the procedures used in the coupling of the salinity transport model to the quantity flow model. A simple technique where the solute transport by hydrodynamic dispersion and convection were treated separately was used. The study results showed that the test strategies will not drastically effect the groundwater quality by seawater intrusion. (Author's abstract)
W86-04072

NITRATE CONCENTRATIONS IN MUNICIPAL WELLS LOCATED WITHIN A RIVER BED,
Nebraska Univ. at Omaha. Dept. of Civil Engineering.
For primary bibliographic entry see Field 4B.
W86-04078

CONCENTRATION OF ROTAVIRUS BY ULTRAFILTRATION,
Queen Elizabeth II Medical Center, Nedlands (Australia). Combined Clinical Microbiology Service.
J. Jansons, and M. R. Bucens.
Water Research WATRAG, Vol. 20, No. 1, p 79-83, January 1986. 3fig, 1 tab, 20 ref.

Descriptors: *Rotaviruses, *Ultrafiltration, *Wastewater treatment, *Water pollution treatment, Groundwater recharge, Aquifers, Enteric viruses, Adsorption, Elution, Filtration, Protein wash, Enzyme-Linked Immunosorbent Assay, ELISA.

The use of wastewater for the recharge of groundwater aquifers offers a practical and economic method for its disposal. In order to overcome the problem of contamination of the aquifer with human pathogens which include enteric viruses, careful studies of the survival and movement of these agents must be performed. The currently accepted procedure for concentrating viruses from large volumes of water is the Viradel method, which utilizes the filter adsorption-elution principle, with secondary concentration carried out by membrane filtration, aluminum hydroxide precipitation or organic flocculation. However, this method is known to be tedious and time consuming, exposing viruses to high and low pH during adsorption and elution, often with virus survival. These factors have created a need for the development of concentration techniques that would enable more reliable detection of a broad range of enteric viruses. In this study a number of parameters were varied in an attempt to optimize recoveries via hollow fibre ultrafiltration evaluated for its capacity to concentrate human rotavirus from experimentally contaminated groundwater. The results of these experiments suggest that virus recovery is greatly improved by utilizing either a protein wash with beef extract or by backflushing the hollow fibres with phosphate buffered saline. An enzyme-linked immunosorbent assay (ELISA) was used to determine rotavirus recoveries after concentration. (Lantz-PTT)
W86-04112

REMOVAL OF NITRATE IN DRINKING WATER BY ION EXCHANGE - IMPACT ON THE CHEMICAL QUALITY OF TREATED WATER,
Poitiers Univ. (France). Lab. de Chimie de l'Eau et des Nuisances.
For primary bibliographic entry see Field 5F.
W86-04128

MONITORING OF ENTEROVIRUSES IN THE WATER SUPPLY OF BARCELONA FROM SURFACE WATER OF THE RIVER LLOBREGAT (CONTROLE D'ENTEROVIRUS DAS L'APPROVISIONNEMENT A BARCELONE PAR L'EAU DE SURFACE DU FLEUVE LLOBREGAT),
Sociedad General de Aguas de Barcelona (Spain).
F. Ribas, J. M. Hugueut, and J. Perramon.
Aqua AQUAAA, No. 1, p 34-44, 1986. 3 fig, 12 tab, 2 ref.

Descriptors: *Enteroviruses, *Water supply, *Barcelona, *Surface water, *Llobregat River, Adsorption, Elution, Water analysis, Physiochemical properties, Bacterial analysis, Potable water, Drinking water, Spain.

Described is enterovirus control in the water supply to Barcelona by superficial water from the river Llobregat during a period of two years. First, the implementation of a unit to concentrate enterovirus starting from large volumes of water by adsorption/elution on glass dust is studied. Second, a study of 15 Samplings of 10 points of the Llobregat basin analyzing the enterovirus as well as several physicochemical and bacteriological parameters is conducted. Finally, the evolution of the different parameters in the successive phases of potabilization of the superficial water, is being studied. (Author's abstract)
W86-04153

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 1. ESTIMATION TECHNIQUES,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04168

ESTIMATION OF DISTRIBUTIONAL PARAMETERS FOR CENSORED TRACE LEVEL WATER QUALITY DATA. 2. VERIFICATION AND APPLICATIONS,
Geological Survey, Reston, VA.
For primary bibliographic entry see Field 5A.
W86-04169

TREATMENT OPTIMIZATION OF MUNICIPAL WASTEWATER AND REUSE FOR REGIONAL IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
For primary bibliographic entry see Field 3C.
W86-04196

WASTE TREATMENT/DISPOSAL SITE EVALUATION PROCESS FOR AREAS UNDERLAIN BY CARBONATE AQUIFERS,
Minnesota Pollution Control Agency, Roseville.
J. A. Magner, P. R. Book, and E. C. Alexander.
Ground Water Monitoring Review, Vol. 6, No. 2, p 117-121, Spring 1986. 1 tab, 14 ref.

Descriptors: *Waste treatment, *Waste disposal, *Aquifers, *Groundwater pollution, Karsts, Carbonates, Water pollution treatment, Soil texture, Drilling, Erosion, Groundwater movement, Case studies, Minnesota.

Fractured carbonate or karst aquifers are highly susceptible to contamination. In Minnesota, the areas underlain by karst aquifers are often characterized by thin soil cover, poorly cased wells and/or collapse features. When coupled with improper land use decision these aquifers have become extensively contaminated. Evaluation of existing or potentially contaminated sites has required the development of unique site evaluation techniques or combinations of techniques. Shallow geophysics have been used successfully to determine subsurface karst features, pinpoint locations for additional investigations and evaluate pump-test data. Soil texture, density and relative moisture content have been closely examined and criteria have been established, to evaluate subsurface erosion susceptibility. Percent rock core recovery, mechanical response of drilling and drilling fluid loss have been used to characterize the secondary porosity and potential contamination susceptibility of the carbonate roc nonuniform lateral inflow, since at least parts of the solution are known analytically. (Geiger-PTT)
W86-04219

ANALYSIS OF A CONTAMINATED BEDROCK AQUIFER BY MEANS OF A PACKER AND ATTEMPTS AT REMEDIATION USING A PACKER,
Olin Chemical Group, Charleston, TN.
For primary bibliographic entry see Field 5B.
W86-04220

RIPARIAN LOSSES OF NITRATE FROM AGRICULTURAL DRAINAGE WATERS,
North Carolina Agricultural Research Service, Raleigh.
For primary bibliographic entry see Field 5B.
W86-04260

NUTRIENT REMOVAL POTENTIAL OF SELECTED AQUATIC MACROPHYTES,
Central Florida Research and Education Center, Sanford, FL.
K. R. Reddy, and W. F. DeBusk.
Journal of Environmental Quality, Vol. 14, No. 4, p 459-462, October-December 1985. 2 fig, 3 tab, 22 ref.

Descriptors: *Aquatic Plants, *Nitrogen Removal, *Phosphorus Removal, *Wastewater Renovation, Water Hyacinth, Water Lettuce, Pennywort, Duckweed, Azolla, Salvinia, Egeria, Denitrification.

The role of eight aquatic macrophytes in removing N and P from nutrient enriched waters was evaluated using microcosm retention ponds. The aquatic macrophytes included water hyacinth (Eichhornia crassipes), water lettuce (Pistia stratiotes), pennywort (Hydrocotyle umbellata), duckweeds (Lemna minor Spirodela polyrhiza), azolla (Azolla caroliniana), salvinia (Salvinia rotundifolia), and a submersed macrophyte, egeria (Egeria densa). Nitrogen removal by aquatic macrophyte systems was in the order of water hyacinth > water lettuce > pennywort > Lemna > Salvinia > Spirodela > egeria during the summer season, while pennywort ranked first during the winter followed by water hyacinth, Lemna, water lettuce, Spirodela, Salvinia, and egeria systems, while pennywort and Lemna showed high P removal rates during the winter compared to other plants. Nitrogen and P removal were generally higher in summer than winter. Plant uptake accounted for 16 to 75% of total N removal, and 12 to 73% of total P removal, indicating the possibility of N and P

removal by the mechanisms other than assimilation by plants. (Author's abstract)
W86-04262

COOPERATIVE SERVICE ARRANGEMENTS,
Department of Commerce, Washington, DC.
R. K. Hedge, Jr., and D. J. Eaton.
Southwest and Texas Water Works Journal STWJDC, Vol. 67, No. 4, p 5, 6, 8, 10, July 1985.

Descriptors: *Drinking water, *Water treatment, Water treatment facilities, *Water supply, *Water law, Water policy, Legal aspects, Public policy.

Texas water law establishes the community's prerogative to decide the manner in which it will supply water to local residents. Many communities have chosen to maintain independent water supply and distribution systems. However, economic and technical considerations may prompt a re-evaluation of traditional institutional arrangements. Cooperative water supply arrangements may provide a means for checking the rising cost of water service and minimizing any added expenses associated with achieving federal drinking water quality standards. A cooperative water supply arrangement may follow two alternative patterns. In the first, called procedural adaptation, each participating water system maintains an independent identity, but all cooperate in acquiring and/or treating water. The second approach involves the combining of water systems to form a new entity, which is a structural adaptation. The state and local laws establish the parameters for organizational change and system financing, although final community decisions will likely be shaped by logal, economic, and political influences. (Geiger-PTT)
W86-04283

COMPUTERS JOIN THE MAINTENANCE TEAM,
Saint Petersburg City Public Works, FL.
For primary bibliographic entry see Field 6A.
W86-04302

MUDDY WATER AND AMERICAN AGRICULTURE: HOW TO BEST CONTROL SEDIMENTATION FROM AGRICULTURAL LAND,
Purdue Univ., Lafayette, IN. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 4D.
W86-04303

MIXING OF A STRATIFIED RIVER BY BARGE TOWS,
Minnesota Univ., Minneapolis. Dept. of Civil and Mining Engineering.
H. G. Stefan, and M. J. Riley.
Water Resources Research WRERAO, Vol. 21, No. 8, p 1085-1094 August 1985. p 1085-1094, 14 fig, 3 tab, 11 ref.

Descriptors: *Navigation, *Stratification, *Destratification, *Barges, *Mixing, Rivers, Effluents, River flow, Flow rates, Flow velocity, Surges, Turbulent flow, Water quality, Path of pollutants.

The effect of commercial navigation on the mixing and reestablishment of stratification was studied in the upper Mississippi River downstream from a major wastewater effluent site and in a laboratory flume. Mixing effectiveness increases from single towboats to unloaded barges to loaded barge tows. Energy expenditure by barge tows per foot of river length traveled is much larger than work done by gravity forces of the free-flowing river to overcome bottom shear. The displacement of water by loaded barge tows appears to be more significant than the jet effect of the towboat propellers. One passage usually causes complete vertical mixing in the path of the tow. Surface waves and internal waves generated by a towboat passage cause surging of the effluent for up to 30 min after passage. Reestablishment of stratification is controlled by mean river velocity and the frontal velocity of the density current resulting from the discharge. Calculated and observed reestablishment times depend on distance from the outlet and strength of the stratification. Order of magnitude comparisons of calculated and observed reestablishment times were in good agreement. Reestablishment of stratification may take from 15 to 45 min at a distance of only 1000 ft from an outfall. Water quality models and field studies in impounded rivers with high navigation frequency should take into account the mixing and transport effects of towboats, especially under low flow conditions. (Geiger-PTT)
W86-04306

CLOSTRIDIUM PERFRINGENS, A RELIABLE INDICATOR OF STREAM WATER QUALITY,
Hawaii Univ. at Manoa, Honolulu. Water Resources Research Center.
R. S. Fujioka, and L. K. Shizumura.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 986-992, October, 1985. 2 fig, 5 tab, 18 ref. Dept. of Int. Grant No. 14-34-0001-1113.

Descriptors: *Water quality, *Stream pollution, *Water quality standards, Water analysis, Bacteria, Coliforms, Clostridium, Enteric bacteria, Streptococcus, Recreation, Water pollution sources.

The use of C. Perfringens in place of fecal streptococci as an indicator of water quality in recreational streams in Hawaii was investigated. Densities of indicator bacteria were measured in water from the Kipapa Stream and South Ahuimanu Stream, both of which receive wastewater effluent from treatment plants operated by the City and County of Honolulu. Results showed that in streams not receiving wastewater, the concentrations of C. perfringens are consistently low, while the concentrations of fecal coliforms and fecal streptococci vary considerably and are often very high. On the other hand, stream samples below effluent discharge sites consistently contain increased concentrations of C. perfringens which reflects the dilution of effluent by the stream. In addition, it was concluded that the assumption that waste water is the primary source of fecal coliforms in streams is not valid, and that the common practice of analyzing stream samples obtained downstream from an effluent discharge site for fecal coliforms and fecal streptococci as a means of assessing the effects of discharge is not conclusive. Based on these findings, a standard of 50 C. perfringens/100 mL instead of 200 fecal coliforms/100 mL is recommended as the recreational standard for streams in Hawaii. (Geiger-PTT)
W86-04328

CURRENT STATUS IN USE OF FLEXIBLE EFFLUENT STANDARDS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
J. C. Lamb,III, and D. B. Hull.
Journal of the Water Pollution Control Federation, Vol. 57, No. 10, p 993-998, October, 1985. 10 tab, 6 ref.

Descriptors: *Water quality standards, *Surveys, *Effluent limitations, Cost analysis, Capital costs, Operating costs, Seasonal variation, Permits, Water Law, Administrative agencies, Administrative regulations, Monitoring.

A questionnaire that included 24 inquiries about policies, practices, and agency experiences concerning flexible effluent standards and discharge monitoring from municipalities and industries was sent to key personnel in all state agencies. From the 48 replies received, the following conclusions were drawn about the use of flexible standards in the U.S. Of the 48 states that responded, 45 use flexible effluent standards to some degree in their pollution control programs. The uses of flexible standards among the states vary substantially with respect to the number of permits that include them, the types of dischargers to which they are offered, the types of water quality parameters for which they are issued, and how they are implemented in the state programs. The principal perceived disadvantages of flexible standards include increased complexity of the approach, difficulty and higher cost of implementation, and additional personnel requirements. The principal perceived advantages in using flexible standards include reductions in capitol costs, operating costs, and energy consumption. Few states had solid information on the savings that result from the use of flexible effluent standards. Most of the states expect to increase use of flexible standards in the future. The three states that reported that they do not use the flexible standards anticipate initiating their use in the future. (Gieger-PTT)
W86-04329

PERCENTILE ESTIMATION PROCEDURES FOR WATER QUALITY MANAGEMENT,
Water Research Centre, Swindon (England). Swindon Engineering Centre.
For primary bibliographic entry see Field 7C.
W86-04340

CMA: AN ALTERNATIVE TO ROAD SALT,
Defense Environmental Leadership Project, Washington, DC.
L. P. Boice.
Environment ENVTAR, Vol. 28, No. 1, p 5 and 45, January-February 1986. 2 ref.

Descriptors: *Calcuium magnesium acetate, *Road salt, *Sodium, *Deicer, *Highways, *Nonpoint pollution sources, *Surface runoff, Cost, Acid rain, Water supply, Contamination, Highway icing, Acidic soils.

The characteristics of calcium magnesium acetate (CMA) as a substitute for salt as a highway deicer are discussed. Road salt is responsible for costly rusting of vehicles, bridges, and road surface retaining rods, as well as water supply contamination in the northeastern United States. CMA is the most promising among several alternative deicers that have been studied. Its main drawback remains the lack of an economical and reliable means of production. Although it is nearly 20 times as expensive as road salt, it does not harm the environment and may actually yield some benefits, including neutralizing acidified solids and waters. (Rochester-PTT)
W86-04359

GROUNDWATER: SAVING THE UNSEEN RESOURCE,
D. E. Burmaster.
Environment ENVTAR, Vol. 28, No. 1, p 25-28, January-February 1986. 11 ref.

Descriptors: *Groundwater, *Aquifers, Reviews, Recommendations, Monitoring, Classification, Data Collection, Analysis, Enforcement, Regulations, Surface-water Management, Contamination.

The report of the National Groundwater Policy Forum is reviewed. The history of the report and of the Environmental Protection Agency's groundwater protection strategy are discussed. The Forum urges every state that has not already done so to enact legislation to affirm the public interest in groundwater protection and adopt the comprehensive programs necessary to manage groundwater effectively. It further recommends that Congress embody the intent of groundwater management in federal law by declaring that the goal of the United States is to protect the physical, chemical, and biological integrity of the nation's groundwater resources and ensure that they are not degraded. Specific recommendations for each state's program cover the following: comprehensive aquifer mapping, anticipatory classification of aquifers, ambient groundwater standards, contamination control, monitoring, data collection, and data analysis programs, effective enforcement provisions, surface-use restrictions to protect groundwater, control of withdrawals, coordination of groundwater and surface-water management, and coordination of groundwater programs with other relevant natural-resource protection programs. (Rochester-PTT)
W86-04360

VARIANCE ANALYSES AND CRITERIA FOR TREATMENT REGULATIONS,
Montana State Univ., Bozeman. Dept. of Civil

Engineering and Engineering Mechanics.
For primary bibliographic entry see Field 5D.
W86-04369

RETURNING RECENTLY COVERED RESERVOIRS TO SERVICE: HEALTH AND AESTHETIC CONSIDERATIONS,
Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W86-04376

DESTRATIFICATION AT BEWL BRIDGE RESERVOIR, KENT,
Mid Kent Water Co., Canterbury (England).
M. J. Bailey.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol. 40, No. 1, p 29-36, February 1986. 3 fig.

Descriptors: *Reservoir operation, *Compressed air, Water treatment, England, Raw water, Capital costs, Operating costs.

The original, temporary, and permanent destratification systems installed at Bewl Bridge reservoir (River Medway Scheme, England) are described, including details of the installation, operation, capital costs and running costs, and resultant water quality. The permanent destratification system consisted of a compressor delivering 94 liter/sec of air at a pressure of 7 bar to a 200 meter lond, 50mm diameter perforated pipe with 1 mm diameter holes at 3 mm centers. A 100 m length of plain pipe was used to connect the perforated pipe to the air source. The system cost 14,360 British pounds. The system has been both effective and reliable since installation. Minor modifications included addition of an ammeter to monitor the performance and a time switch to accomodate intermittent operation to take advantage of lower electric rates. (Rochester-PTT)
W86-04378

INTERFERENCE IN THE BACTERICIDAL PROPERTIES OF INORGANIC CHLORAMINES BY ORGANIC NITROGEN COMPOUNDS,
California Univ., Irvine. Program in Social Ecology.
For primary bibliographic entry see Field 5B.
W86-04427

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,
Kennedy/Jenks Engineers, San Francisco, CA.
J. A. Campbell, and W. R. Mabey.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 58-62, Fall 1985. 2 tab, 5 ref.

Descriptors: *Groundwater quality, *Monitoring, *Data acquisition, *Data interpretation, Mathematical analysis, Statistical analysis, Boreholes.

The recognition and assurance of the quality of groundwater monitoring data are crucial to the correct assessment of the magnitude and extent of a groundwater contamination problem. The article addresses an approach being developed to systematically evaluate the quality of a given set of groundwater monitoring data collected during site investigation/remedial action efforts. The system consists of a checklist of criteria, grouped into four major categories, which can be applied to laboratory or field measurements. The first category, basis of measurement, considers whether the appropriate sampling, boring and/or analytical methods were chosen to obtain the measurement and the limitations of each method. Second, the application of the method is assessed. This includes examination of the extent to which procedures were correctly performed, the use of quality control measures and calibration, and possible sources of error in the measurements. Third, evaluation of applied statistical methods is made, with consideration given to which statistics are meaningful in a given context and whether measurements are reproducible. The final category, corroborative information, considers whether independent data or other information are available that add credibility to the values measured. This system has been found to be useful in the multidisciplinary efforts that require measurement and use of groundwater monitoring data. It is suggested that a system such as the one presented here be applied in the design of a site investigation or groundwater monitoring program, and that sufficient information be documented in field notes and reports to allow the quality of resulting data to be fully evaluated. The more that quality criteria are considered prior to data collection, the more certain it is that high quality data will be produced. (Lantz-PTT)
W86-04472

COASTAL ECOLOGY AND THE ARCTIC OIL INDUSTRY: SOME ELEMENTS FOR FUTURE OIL-SPILL CONTINGENCY PLANNING,
Norges Tekniske Hoegskole, Trondheim. Selskapet for Industriell og Teknisk Forskning.
E. Sendstad.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 87-96, 1986. 3 fig, 21 ref.

Descriptors: *Coastal ecology, *Arctic, *Oil industry, *Cleanup operations, *Future planning, Oil spills, Oil recovery, Environmental protection, Enhanced oil recovery.

The ecological vulnerability of shorelines to oil contamination varies and their self-cleaning ability may be extensive. The ice may restrict the spread of oil. In the biologically active season, oil contamination in this environment will affect an important foodchain. Both the ice and shoreline environments have elements which positively and negatively influence the planning of countermeasures for oil-spills. Offshore oil production in the Arctic is expected to be dependent on enhanced oil recovery ('EOR'). Thus any future environmental impact analyses of the offshore petroleum industry should include this aspect. It is important to analyze the functional aspects of arctic ecology to single out the most vulnerable situations. An oil-spill clean-up plan should avoid vulnerable areas and seasons of the year, and use effective countermeasures in the less sensitive situations. (Author's abstract)
W86-04482

SOME CONSIDERATIONS OF ENHANCED WATER QUALITY MONITORING IN THE NORTHWEST TERRITORIES: AN INLAND WATERS DIRECTORATE PERSPECTIVE,
Inland Waters Directorate, Yellowknife (Northwest Territories).
B. Olding.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 171-177, 1986. 1 tab, 10 ref, append.

Descriptors: *Water quality, *Monitoring, *Northwest territories, *Inland Waters Directorate, *Water pollution control, Water quality standards, Water quality control, Legal aspects, Networks, Future planning.

Environment Canada has for over 15 years operated a network of water quality stations in the NWT. The objectives of the network were to provide a baseline of water quality data against which future changes could be measured. Contemporary monitoring must now address the biological component of the aquatic environment, the effects of development on the aquatic environment, the effects of development on the aquatic environment, and the formulation and application of in-stream water quality objectives. Interjurisdictional water quality at the Territorial-Provincial border, and issues associated with precious metals, base metals, hydrocarbons, uranium exploration and long-range air pollution constitute new challenges for water quality monitoring programs. The paper considers aspects of an updated monitoring program, focusing on the delineation of ambient variability and the needs for particular research in the development of aquatic water quality criteria, guidelines and use-specific water quality objectives for northern water-courses. (Author's abstract)
W86-04489

CONTINUING THE DEVELOPMENT OF MUNICIPAL EFFLUENT GUIDELINES FOR THE NORTHWEST TERRITORIES,
Department of the Environment, Yellowknife (Northwest Territories). Northwest Territories District Office.
R. J. Kent.
Water Science and Technology WSTED4, Vol. 18, No. 2, p 179-184, 1986. 5 tab, 7 ref.

Descriptors: *Wastewater treatment, *Effluents, *Municipal wastewater, *Northwest Territories, *Water quality standards, Standards, Cold regions.

The background to and the rationale for the Guidelines for Municipal Type Wastewater Discharges in the Northwest Territories is discussed. Particular attention is given to the development of the Effluent Quality of Municipal Wastewater Discharges table, which was based upon expected lagoon performance. Also included is a discussion of the flow ratio and dilution ratio concepts. The viability of these concepts was assessed against the available data. It appears that the guidelines misjudged both the number of coliform bacteria in northern raw sewage and the removal efficiency for these organisms in lagoons. It appears unlikely that lagoons can consistently meet the guideline requirements. More information and research is necessary before a complete assessment can be performed. (Author's abstract)
W86-04490

CHICAGO AREA'S TUNNEL AND RESERVOIR PLAN,
Metropolitan Sanitary District of Greater Chicago, IL.
F. E. Dalton, and R. R. Rimkus.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1114-1121, December 1985. 10 fig.

Descriptors: *Flood Prevention, *Combined sewer overflows, *Canals, *Navigable waters, Recreation, Cost effectiveness, Tunnels, Reservoirs, Chicago, Illinois.

The history, system characteristics, objectives, and benefits of the Tunnel and Reservoir Plan (TARP) of the Metropolitan Sanitary District of Greater Chicago are described. TARP includes about 21000 km of 2.7-to 10-m finished diameter tunnels and is intended to collect urban stormwater runoff and hold it for later treatment. The three goals of TARP are (1) preventing pollution of Lake Michigan, which now occurs due to reversal of rivers during storms. (2) elimination of combined sewer overflows, and (3) providing an outlet for floodwaters. With the improved quality of waterways, less water will have to be diverted from Lake Michigan to dilute the flow of formerly polluted rivers and streams. Diversion requirements for navigation could be reduced from 2.7 to 0.8 cu m/sec because of TARP, leaving more lake water available for municipalities. By regulating flow, TARP will make possible the more efficient use of wastewater treatment plants, thus eliminating the need for approximately $1 billion in plant expansion. The program also will save an estimated $300 million in local sewer improvements. Elimination of flooding and flood damage will yield in $1.57 in anti-flood and anti-pollution benefits for every $1.00 spent. (Rochester-PTT)
W86-04498

PROCESS CONTROL AND DATA ACQUISITION COMPUTERS IN THE WATER INDUSTRY,
Brown Boveri Kent (East Africa) Pty Ltd., Singapore.
R. A. Taylor.
Water Science and Technology WSTED4, Vol. 18, No. 3, p 81-94, 1986. 5 fig.

Descriptors: *Data acquisition, *Computers, *Water management, *Process control, Monitoring, Information systems, Supervisory Control And Data Acquisition, SCADA, Water treatment, Wastewater treatment, Water pollution control.

In the water industry, both main frame and personal computers are used, mainly as clerical and management tools. However, this paper refers more to computers in applications which are not well known or publicized, ie. the control of processes, the monitoring of data and the transmission, displaying and logging of this informationin a form which can be utilized in various ways in the water industry. The generic jargon for this is SCADA (Supervisory Control And Data Acquisition). Discussed here is the need for SCADA systems, and how they can be applied to: (a) the treatment and distribution of potable water, (b) the treatment of wastewater and effluent, and (c) the monitoring and control of pollution levels in water and wastewater supplies, including that of primary catchment water. Some typical examples of SCADA applications in the Far East are included. (Lantz-PTT)
W86-04519

ANTHROPOGENIC, POLYHALOGENATED, ORGANIC COMPOUNDS IN NON-MIGRATORY FISH FROM THE NIAGARA RIVER AREA AND TRIBUTARIES TO LAKE ONTARIO,
Indiana Univ. at Bloomington. Dept. of Chemistry.
For primary bibliographic entry see Field 2H.
W86-04527

EVALUATION OF MANAGEMENT ASPECTS OF A HYPERTROPHIC AFRICAN IMPOUNDMENT,
National Inst. for Water Research, Pretoria (South Africa).
J. A. Thornton, K. L. Cochrane, A. C. Jarvis, T. Zohary, and R. D. Robarts.
Water Research WATRAG, Vol. 20, No. 4, p 413-419, April 1986. 1 fig, 4 tab, 37 ref.

Descriptors: *Reservoirs, *Africa, *Evaluation, *Management planning, Hartbeespoort Dam, Eutrophication, Lake restoration, Eutrophic lakes, Ecological effects, Reservoir management, Biological treatment.

Simple empirical models were used to evaluate the potential impact of a number of eutrophication management strategies on a southern African manmade lake. Both the traditional approach to the management of eutrophic systems, that of using point source control of nutrients to restore a system to a less enriched state, and a more pragmatic approach of productively utilizing an enriched system, were considered. Predictions were made of present conditions in the lake to establish the validity of the models used, and future conditions, following implementation of point source control, were described using the models. Alternative management strategies of food chain manipulation and protein harvesting were assessed in light of the anticipated altered state of the impoundment. The present findings indicate that alternative management options are probably not viable for the impoundment under prevailing economic conditions. The need for more sophisticated models on which to base biological management decisions was demonstrated. (Author's abstract)
W86-04569

WASTE MANAGEMENT PLANNING,
Durham Univ. (England). Faculty of Law.
L. D. Guruswamy.
Journal of Environmental Management JEVMA, Vol. 21, No. 1, p 69-84, July 1985. 1 fig, 29 ref.

Descriptors: *Waste management, *Management planning, *Waste disposal, *Water pollution sources, *Water law, Environmental impact statement, Environmental effects, Project planning, Decision making, Future planning, Fate of pollutants, Air pollution, Water quality control, Water quality management, Water quality standards, England.

The possibility of managing wastes is explored within the framework of an integrated environmental resource strategy. The British Government has adopted a planning system using the concept of the best practical environmental option of integrated waste management planning. The best practical environment option involves the examination of land and air contributions to water pollution. Environmental quality objectives are used to find the solution that would allow wastes to be distributed in a way that is least harmful to the environment. In order to achieve the best balance of emissions and discharges for all media, it is necessary to ascertain the nature and extent of all wastes, together with their sources, pathways and impacts. Two statutes enable this kind of survey to be undertaken, namely, the Control of Pollution Act and the Town and Country Planning Act of 1971. The Durham County Council has shown how these two surveys could be amalgamated so that the best practical environmental options for waste disposal planning could be met. Securing the best balance of pollution loads, devising controls and methods to attain these targets, and coordinating the work of the different pollution control agencies are some of the problems that will be encountered in attempting to achieve an integrated environmental resource strategy. (Geiger-PTT)
W86-04590

ANALYSIS OF WATER QUALITY INDICES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
D. Couillard, and Y. Lefebvre.
Journal of Environmental Management JEVMA, Vol. 21, No. 2, p 161-179, September 1985. 3 tab, 48 ref, append. National Research Council of Canada Grant No. A3711.

Descriptors: *Water quality standards, *Water quality, *Data collections, *Literature review, *Indexing, Water quality management, Water pollution control, Hydrologic data collections.

To facilitate communication on water quality among professionals of this resource, several summarizing tools called water quality indices were developed. Because the general features of these indices are little known, this article provides the reader with basic knowledge regarding their main components and the intrinsic characteristics of their operational process. This is then followed by a list of 20 indices grouped in a chart containing five columns headed category, goals, methodology, applicability and notes. The indices considered may be grouped by index category into general water quality indices, specific use quality indices, planning indices, statistical approaches, biological indices and trophic state indices. (Geiger-PTT)
W86-04598

STREAM ACIDITY IN SOME AREAS OF WALES IN RELATION TO HISTORICAL TRENDS IN AFFORESTATION AND THE USAGE OF AGRICULTURAL LIMESTONE,
University of Wales Inst. of Science and Technology, Cardiff. Dept. of Applied Biology.
For primary bibliographic entry see Field 5B.
W86-04600

MANAGEMENT OF OIL POLLUTION OF NATURAL RESOURSES IN NIGERIA,
Ibadan Univ. (Nigeria). Dept. of Geography.
C. O. Ikporukpo.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 199-206, April 1985. 4 tab, 12 ref.

Descriptors: *Oil spills, *Oil pollution, *Nigeria, *Water pollution effects, *Resources management, Resources development, Exploitation, Legislation, Environmental effects, Ecological effects, Management planning, Developing countries, Oily water, Oil recovery, Cleanup operations, Operations, Niger Delta.

Oil spills are prominent features of petroleum exploitation in Nigeria Oil pollution adversely affects the water and soil resources of the petroleum-producing Niger Delta. Oil has been known to contaminate drinking water supplies and destroy the livelihood of fisherman and farmers. Attempts have been made to manage the increasing menace of oil spills by legislative and project implementation approaches. There are various problems in the effective operation of both of these strategies, such as weaknesses in legislation, and lack of rapport between the government, oil-exploiting countries and people living in the oil-producing areas. (Geiger-PTT)
W86-04601

ROLE OF RECREATIONAL BOAT TRAFFIC IN INTERLAKE DISPERSAL OF MACROPHYTES: A NEW ZEALAND CASE STUDY,
New Zealand Electricity Dept., Hamilton.
I. M. Johnstone, B. T. Coffey, and C. Howard-Williams.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 263-279, April 1985. 5 fig, 10 tab, 44 ref.

Descriptors: *Macrophytes, *Aquatic weed control, *New Zealand, *Boating, *Models, Aquatic weeds, Case studies, Distribution patterns lakes, Navigable waters, Fishing, Recreation, North Island, Decision making.

The distribution of five submersed, long-stemmed, vegetatively reproducing aquatic weed species in 107 lakes in North Island, New Zealand, was studied. Plant distribution was significantly associated with boating and fishing activities, suggesting that dispersal is related to these human activites, rather than to natural vectors such as birds and wind. Boat inspections at 14 lakes showed that 5.4% of the boats entering the lakes carried vegetative fragments of aquatic weeds, and that, of those, 27% had come from another lake. Boats leaving lakes, however, carried weed fragments only when the haul-out area was near weed beds, suggesting that weed control near haul-out areas would greatly reduce the probability of boat-mediated interlake dispersal. Biotic factors (lateral bud frequency, internode length, resistance to desiccation) that may affect dispersal ability are described. A model for predicting the frequency of interlake dispersal of macrophytes by recreational boat traffic is developed that can help with management decisions for locally generated data. Use of the model shows that, in the North Island of New Zealand, recreational boat traffic is unlikely to spread geographically remote infestations to other lakes. (Geiger-PTT)
W86-04604

COMMUNITY RESPONSES TO NON-POINT POLLUTION FROM AGRICULTURE,
Griffith Univ., Nathan (Australia). School of Australian Environmental Studies.
For primary bibliographic entry see Field 5B.
W86-04605

GROUNDWATER MONITORING WITHIN AN AQUIFER - A PROTOCOL,
Albuquerque Environmental Health and Energy Dept., NM.
C. D. Rail.
Journal of Environmental Health JEVHAH, Vol. 48, No. 3, p 128-132, November/December 1985. 21 ref.

Descriptors: *Monitoring, *Aquifers, *Project planning, *Water quality control, *Water quality management, Computer models, Water law, Evaluation, Groundwater management, Groundwater pollution, Water pollution sources.

Good quality water is necessary for health, aesthetic, and economic reasons. A comprehensive groundwater monitoring database including quality and quantity parameters within an aquifer is valuable, not only in terms of preventing direct contamination of an underground water area, but in applying corrective measures when problems have been identified. The basics of how to establish a systematic groundwater monitoring plan for any underground water source are presented. The initial plan should: select and assemble participants; establish a purpose and development plan, technically evaluate the aquifer by identifying pollution potential, using applicable available technologies, and determining present and future demands on the aquifer; select computer models for data summarization; evaluate water law and the responsibilities of municipalities and government; and prepare and implement the plan. Although the emphasis on

developing a groundwater monitoring plan is placed at the local level, it is recognized that in some instances implementation of such a plan must come from state or federal sources. (Geiger-PTT)
W86-04611

ORGANIC CONTAMINANTS IN GROUNDWATER,
Environmental Protection Agency, Dallas, TX. Region VI.
O. T. Love, Jr.
Southwest and Texas Water Works Journal STWJDC, Vol. 67, No. 10, p 6-8, January 1986. 1 fig, 3 tab, 12 ref.

Descriptors: *Organic compounds, *Groundwater pollution, *Monitoring, Test wells, Water quality standards, Organic solvents, Organic pesticides, Drinking water.

Organochlorine solvents, pesticides, or petroleum distillates are being detected in up to 20% or more of the groundwater sources of drinking water in the United States. Two of the five states in EPA Region VI, New Mexico and Texas, have an organic monitoring program under way, but it will take from two to five years to sample all the wells. Water purveyors can facilitate this program by installing a sample tap at each wellhead. Some states, such as Connecticut, Florida, California, and New Jersey have proposed (and in some cases promulgated) regulations concerning routine testing for organic chemicals in community water supplies. The EPA in 1985 proposed maximum contaminant levels for eight volatile organic chemicals (seven organohalides and one aromatic compound) along with a monitoring requirement for several dozen organic compounds that, if present, would be detected during the analysis for the 8 volatile compounds with proposed maximum concentration levels. Recommended maximum contaminant levels are being proposed for several additional synthetic organic chemicals. (Geiger-PTT)
W86-04617

SOLID WASTE MANAGEMENT FOR UTILITY RECONVERSIONS,
Stone and Webster Management Consultants, Inc., New York.
G. K. Welshans.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 29-39, September 1985. 1 fig, 3 tab, 8 ref, 4 append.

Descriptors: *Solid waste disposal, *Waste management, *Powerplants, *Public utilities, *Environmental impact statement, *Groundwater pollution, Public health, Site selection, Legal aspects, Licensing, Environmental effects, Design criteria, National Environmental Policy Act, Resources Conservation and Recovery Act.

Since the OPEC oil embargo, several utilities are reconverting some of their powerplants from oil to coal firing. In accordance with the National Environmental Policy Act and the Resource Conservation and Recovery Act, the utilities are required to develop comprehensive solid waste management plans. In most cases, the environmental licensing for these projects requires the preparation of a Draft Environmental Impact Statement, in which solid waste management impacts, as well as alternatives to disposal are discussed. Federal law seeks to protect human health and the environment by controlling all exposure pathways from pollutant degradation by solid wastes. In selecting a site for a solid waste management facility, factors of groundwater contamination, facility flooding, wetlands, and endangered species must be considered. The team of experts assigned to site selection should include a solid waste engineer, a hydrogeologist, aquatic and terrestrial ecologists, a land use and aesthetics specialist, and a noise specialist. A comprehensive subsurface study and analysis plan is needed for the selected site to determine the nature of the onsite soils, permeabilities, and the depth direction, and flow characteristics of the groundwater. Groundwater monitoring wells must be installed to obtain samples for laboratory analysis. The components of a solid waste management facility application are discussed. The utility should inform the public of its plans for solid waste management to guard against public opposition to the project. (Geiger-PTT)
W86-04635

CLAY LINER CONSTRUCTION AND QUALITY CONTROL,
Duke Univ., Durham, NC. Dept. of Civil and Environmental Engineering.
J. J. Pierce, G. Sallfors, and E. Peterson.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 13-24, February 1986. 3 tab, 9 ref. EPA Contract No. 68-03-3149, 24-2.

Descriptors: *Hazardous materials, *Waste disposal, *Lining, *Clays, *Testing procedures, Comparison studies, Waste management, Impervious soils, Soil compaction, Quality control, Permeability coefficient.

Soil handling and liner construction practices at hazardous waste management facilities are documented. Soil characterizations, processing techniques, construction methods, and quality control of constructed liners are reviewed and compared. Results from 23 facilities nationwide indicate widely different testing and construction methods. Uncompacted lift thicknesses of 0.15-0.3 m appear to be widely accepted in the field for best compaction of a clay liner. Most clay liner construction programs do not include measurement of moisture content, and no standard procedure exists for wetting clays that are too dry for compaction. Sheepsfoot rollers are most often used for compacting clay. Two types of testing are most common for liner quality control: checking moisture and density with a nuclear density meter during and after construction; and undisturbed soil sampling for hydraulic conductivity testing of the completed liner. Field hydraulic conductivity tests are rarely used to check the integrity of a clay liner. Soil testing laboratories sometimes prepare soil samples in a manner that doe not reflect actual field conditions. (Geiger-PTT)
W86-04638

ASSESSING PHOSPHORUS CONTROL IN THE JAMES RIVER BASIN,
Virginia Univ., Charlottesville. Dept. of Civil Engineering.
W.-S. Lung.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 44-60, February 1986. 12 fig, 4 tab, 6 ref.

Descriptors: *Water quality, *Hydrologic models, *Phosphorus removal, *Nutrients, *Estuaries, Chlorophyll, Algal growth, Eutrophication, Turbidity, Phytoplankton, Limiting nutrients, Biological oxygen demand, Phosphorus, Dissolved oxygen, Nitrogen compounds, James River, Virginia.

A tidally averaged water quality model was used to study the factors limiting the phytoplankton growth in the James River Estuary in Virginia. The water quality constituents simulated by the model are CBOD, dissolved oxygen, organic nitrogen, ammonia nitrogen, nitrite plus nitrate nitrogen, organic phosphorus, inorganic phosphorus, and chlorophyll a. The kinetics of major physical, chemical, and biological processes which link these water quality constituents are modeled in each of the 50 model segments in the longitudinal direction of the upper James River estuary. Model calibration and sensitivity analyses indicate that the phytoplankton growth plays a significant role in contributing to ultimate CBOD through respiration of live phytoplankton as well as recycling of carbon from dead algal biomass. In addition algal growth is important in balancing the dissolved oxygen budget via photosynthesis and respiration. More importantly, turbidity controls the phytoplankton growth. Nutrients (nitrogen and phosphorus) are found not to be a key limiting factor in the upper James River Estuary under the present conditions. However, the model projection analysis indicates that significant phosphorus load reduction from municipal wastewater treatment plants would reduce phosphorus to levels that limit the phytoplankton growth and thereby control phytoplankton biomass to reasonable and manageable levels. (Author's abstract)
W86-04640

RISK PENALTY FUNCTIONS FOR HAZARDOUS WASTE MANAGEMENT,
Notre Dame Univ., IN. Dept. of Civil Engineering.
A. A. Jennings, and P. Suresh.
Journal of Environmental Engineering (ASCE) JOEEDU, Vol. 112, No. 1, p 105-122, February 1986. 3 fig, 1 tab, 27 ref, 3 append.

Descriptors: *Hazardous materials, *Waste management, *Project planning, *Risks, *Decision making, *Algorithms, Mathematical studies, Management planning, Computer models, Mathematical models, Waste disposal, Optimization.

Presented is an algorithm to generate risk penalty functions for optimization planning of regional hazardous waste management. The method has been designed to use existing risk ranking/rating techniques, and to accommodate the relatively high degree of parameter unsurety that exists at early stages of facility planning. The algorithm has also been designed around an explicity analytical solution of the resulting 'fuzzy' matrix problem so that it may be implemented rapidly by a microcomputer. This allows the procedure to be executed in a non-intimidating planning atmosphere with strong user-interactive support. Algorithm approaches may be of great assistance to hazardous waste professionals, public decision makers, environmentalists, and the parties at risk in resolving the tumultuous differences that often result from public hazardous waste deliberations. (Geiger-PTT)
W86-04644

PRACTICAL APPLICATION OF THEORETICAL MODELS TO MAGNETOMETER SURVEYS ON HAZARDOUS WASTE DISPOSAL SITES - A CASE HISTORY,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W86-04654

EFFECT OF THREE DRILLING FLUIDS ON GROUND WATER SAMPLE CHEMISTRY,
Geological Survey, San Antonio, TX. Water Resources Div.
For primary bibliographic entry see Field 5C.
W86-04655

EXAMINATION OF ENVIRONMENTALLY SAFE LEVELS OF ZINC (II), CADMIUM (II) AND LEAD (II) WITH REFERENCE TO IMPACT ON CHANNELFISH NURIA DENRICUS,
Centre for Water Resources Development and Management, Kunnamangalam (India).
For primary bibliographic entry see Field 5C.
W86-04661

RAINFALL AND EPIZOOTIC RIFT VALLEY FEVER,
Food and Agriculture Organization of the United Nations, Kabete (Kenya). Veterinary Research Lab.
F. G. Davies, K. J. Linthicum, and A. D. James.
World Health Organization Bulletin BWHOA6, Vol. 63, No. 5, p 941-943, 1985. 1 fig, 20 ref. Research Grant No. DAMD 17-83-G-9517.

Descriptors: *Rift Valley fever, *Rainfall intensity, *Viruses, *Excess rainfall, Lakes, Mosquitos, Epizootiology, Public health, Kenya.

Epizootic Rift Valley fever (RVF) has occurred in Kenya four times over the last 30 years. Widespread, frequent, and persistent rainfall has been a feature of these epizootic periods. A composite statistic, based upon measurements of these rainfall characteristics, is positive during periods of epizoo-

tic Rift Valley fever. The heavy rainfall raises the level of the water table in certain areas, flooding the grassland depressions (dambos) that are the habitat of the immature forms of certain ground-pool-breeding mosquitos of the genus Aedes. RVF virus is probably transmitted transovarially in these species, very large numbers of which emerge under these damp conditions. This is when clinical signs of the disease are first seen. (Author's abstract)
W86-04663

APPLICATIONS OF FLUORESCENT DYE TRACERS IN THE PLANNING AND HYDROLOGICAL APPRAISAL OF SANITARY LANDFILLS,
Bristol Univ. (England). Dept. of Geography.
P. L. Smart.
Quarterly Journal of Engineering Geology QJEGA, Vol. 18, No. 3, p 275-286. 6 fig, 14 ref.

Descriptors: *Path of pollutants, *Sanitary landfills, *Fluorescent dye tracers, *Leachate, Hydraulic properties, Springs, Groundwater movement, Site selection, Surface water.

Four applications of artificial tracers in the study of sanitary landfill sites were investigated; confirmation of leachate contamination, determination of on-site hydrology, determination of hydraulic properties of landfill materials and prediction of leachate contamination and dilution. These applications are illustrated by seven tracing experiments undertaken at a landfill site in the Jurassic Great Oolite Limestone of the Cotswolds using fluorescent dye tracers. The tracers proved non-conservative, which limited their use in determination of hydraulic properties, but were still detectable more than 5 months after injection. Background fluorescence due to organic materials in landfill leachate and chemical instability caused problems in analysis, but these could be overcome. Overall the tests were successful in identifying the sources and paths of leachate leakage in the landfill, permitting design of effective risks of leachate contamination at surface streams in the vicinity. (Author's abstract)
W86-04679

6. WATER RESOURCES PLANNING

6A. Techniques Of Planning

CONSIDERATIONS FOR DEVELOPMENT OF A BASIN MODEL FOR BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 2A.
W86-03961

OIL SPILL PROTECTION PLANNING FOR NATURAL RESOURCES IN OREGON,
Oregon State Dept. of Environmental Quality, Corvallis.
G. B. Sutherland, I. W. Jones, and R. W. Smith.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 183-186, 2 fig, 5 ref.

Descriptors: *Oil spills, *Environmental effects, *Cleanup operations, *Oregon, Mapping, Oil pollution, Oil, Columbia River, Willamette River, Yaquina Bay, Coos Bay.

A series of oil spill protection plans for natural resources has been developed for high priority areas in Oregon. This series was begun following the Toyota Maru No. 10 oil spill in the Columbia River in 1978 and has continued to the present. The plans are designed for use by the on-scene coordinator, special forces, and advisory agencies. Oil spill protection plans for the lower Columbia and Willamette rivers and the Yaquina Bay estuary are completed, and plans are being developed for the Coos Bay estuary. Each area contains high priority natural resource areas. These include National Wildlife Refuge System lands and waters, estuarine sanctuary lands and waters, critical habitats for endangered species, and spawning or breeding areas for fish and migratory birds. Considerations for access, water intakes, and commercial interests are included in the plans. The method of developing the plans for the three areas is discussed in detail. The process involves locating known vulnerable areas on a series of resource maps, describing the resources and their seasonal vulnerabilities on descriptive charts, and suggesting boom locations, oil containment sites, and access points on protective maps. Resource protection and response is analyzed, and recommendations for improving the process are included for future use by the agencies involved in pollution response and resource management. The level of interagency cooperation necessary for both spill response and detailed resource protection planning is identified. The practical value of this approach to resource protection and contingency planning is discussed. (Author's abstract)
W86-04020

OIL SPILL PREPAREDNESS IN A TROPICAL OFFSHORE AREA,
Smith Associates Consulting System Engineers Ltd., Surrey (England).
G. T. Tan.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 211-218, 3 tab, 5 refs.

Descriptors: *Oil spills, *Cleanup operations, *Planning, *Oil pollution, Environmental effects, Oil, Skimming, Dispersants, SLIK TRAK, Modeling.

The systematic process by which an oil spill preparedness plan was developed for SSB/SSPC operations in the South China Sea used local wind, current, and weather data in a SLIKTRAK model adapted to estimate the spill costs and risks resulting from a well blowout. The model shows that the Sabah and Philippines shores would be likely to be affected, while the Brunei and Sarawak shores have a low probability. The minimum period in which oil will arrive at any shore is three days after the spill. February to early August are likely months in which a spill will arrive at a shoreline. Spills from late August to January are expected to move away from the coast. Mechanical recovery of spilled oil and chemical dispersant spraying from boats is effective from March to September while natural dispersion is enhanced from September to February. The local environmental data and local availability of vessels and resources greatly influence the choice of mechanical cleanup equipment. An ecological marine macrobenthos survey has been carried out in the Sabah and Sarawak coastal waters. The fundamental aim of the program is to develop quantitative data on the current status of selected marine macrobenthic communities in these areas. This data could be used as a reference for comparison against any future surveys so that any environmental effects or modification resulting from oil spills may be assessed. A coastal resources study along the Sarawak coast also was being carried out to determine sensitive areas in order to prioritise the allocation of available oil spill control equipment and resources. Finally, the roles and development of Shell oil spill cooperatives in this region have been based on the tier concept. Under this concept, SSB/SSPC would be primarily responsible for its own spill as the first tier. It is complemented on a reciprocal basis by close cooperation with Brunei Shell as the second tier. The third tier involves the cooperation of the Shell Companies in Southeast Asia - The ROSE scheme. (Author's abstract)
W86-04021

EFFECT OF STOCHASTIC INPUTS AND PARAMETERS IN SOLUE-TRANSPORT MODELING,
Oklahoma State Univ., Stillwater.
For primary bibliographic entry see Field 5B.
W86-04082

MANAGEMENT OF LAKE COMO: A MULTIOBJECTIVE ANALYSIS,
Consiglio Nazionale delle Ricerche, Milan (Italy). Centro di Teoria dei Sistemi.
G. Guariso, S. Rinaldi, and R. Soncini-Sessa.
Water Resources Research WRERAO, Vol. 22, No. 2, p 109-120, February 1986. 12 fig, 12 ref.

Descriptors: *Reservoir operation, *Lake Como, *Multiobjective planning, *Multipurpose reservoirs, Italy, Optimization, Flood protection, Water supply development, Competing use, Electric power production, Management planning.

A heuristic approach for improving the performance of multipurpose reservoirs that have been in operation for a number of years is described. The main characteristic of the method is that the analyst must first learn from the past experience of the manager and synthesize it into a simple operating rule. Then the analyst must point out, with the help of the manager, what the acceptable modifications of such a rule are. After this has been accomplished, the optimal improvements of the operating rule can be obtained by using standard optimization techniques. Quite satisfactory results have been obtained by applying this approach to Lake Como (Northern Italy), which has been regulated since the end of World War II. In fact, the method shows that both flood protection on the lake shores and water supply to the downstream agricultural areas can be substantially improved, without lowering the mean yearly electricity production of the downstream run-of-river plants. For this reason the operating rule proposed by the method has been programmed on a microcomputer, which is now used every day by the manager as an essential support for his final decision. This and the fact that other actions suggested by this analysis have indeed been undertaken by the local authorities gave to this study the change to have a positive and direct impact on the lake management. (Lantz-PTT)
W86-04165

IDENTIFICATION OF WATER DEMAND MODELS FROM NOISY DATA,
A.T. and T. Bell Labs., Inc., Middletown, NJ.
For primary bibliographic entry see Field 6D.
W86-04195

OPTIMIZATION OF REAL-TIME RESERVOIR OPERATIONS WITH MARKOV DECISION PROCESSES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 4A.
W86-04198

PARAMETER ESTIMATION IN WATER RESOURCES PLANNING AND MANAGEMENT: OPTIMAL ACTIONS OR OPTIMAL PARAMETERS,
Duke Univ., Durham, NC. School of Forestry and Environmental Studies.
C. M. Marin.
Water Resources Research WRERAO, Vol. 22, No. 3, p 353-360, March 1986. 7 fig, 3 tab, 16 ref.

Descriptors: *Optimization, *Water resources development, *Water management, Sampling, Management planning, Parametric hydrology.

The optimality of parameter estimates is commonly justified on the basis of their sampling properties in parameter space. However, these criteria may not be necessarily appropriate within the small sample size environment and the management rather than inferential focus of water resource planning decisions. Using two general cases, it is shown that in the presence of parameter uncertainty, 'optimal' parameters, selected on the basis of their sampling properties in parameter space, can instead lead to nonoptimal decisions relative to planning objectives. In either case, alternative Bayesian estimators are presented which, by incorporating parameter uncertainty, lead to uniform improvements in efficiency in action space over the traditional estimators. Incorporation of param-

eter uncertainty will not necessarily lead to uniform improvements, however. A counterexample is presented which shows that the use of noninformative priors, while optimal in the first case, can instead result in uniformly poorer decisions relative to the traditional estimators in the second case. The potential inefficiences due to the use of noninformative measures of uncertainty and/or the misspecification of the prior in Bayesian estimators, provide a motivation for the consideration instead of empirical Bayes methods of estimation. (Lantz-PTT)
W86-04199

COMPUTERS JOIN THE MAINTENANCE TEAM,
Saint Petersburg City Public Works, FL.
G. Sutton.
Water Engineering and Management, Vol. 133, No. 1, p 31-33, January 1986.

Descriptors: *Management planning, *Computers, *Maintenance, *Wastewater facilities, *Water treatment facilities, Decision making, Maintenance costs, Data transmission, Planning.

In St. Petersburg, Florida, the water and wastewater treatment facilities were organized under a centralized Maintenance Management System (MMS) which used an equipment specific management scheme and the CAMEO (Computer Assisted Management System for Environmental Operations) method to organize maintenance tasks. The scheduling of preventive maintenance is solely controlled by the computer. Long-range planing tools provided by the CAMEO system are the Equipment History and Master Listing reports. These documents provide cost and repair history for any specified unit, class or type of equipment. The system helps document manpower needs and can be used to justify costs if a maintenance item is challenged by budget limitations. The program can also be used in assessing resources that management will need to meet future challenges. (Geiger-PTT)
W86-04302

EVALUATING A CUMULATIVE IMPACT ASSESSMENT APPROACH,
Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
For primary bibliographic entry see Field 6G.
W86-04539

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. I. IMPLEMENTATION AND EFFECTIVENESS,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W86-04596

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. II. CONSENSUS ON CRITICAL ISSUES IN ENVIRONMENTAL MONITORING PROGRAM DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
For primary bibliographic entry see Field 6G.
W86-04597

SIMULATION MODEL TO FORECAST PROJECT COMPLETION TIME,
Technical Univ. of Nova Scotia, Halifax. Faculty of Engineering.
H. N. Ahuja, and V. Nandakumar.
Journal of Construction Engineering and Management (ASCE) JCEMD4, Vol. 111, No. 4, p 325-342, December 1985. 8 fig, 11 ref.

Descriptors: *Project planning, *Models, *Monte Carlo method, *Computer models, Simulation analysis, *Project Duration Forecasting Model, Dam construction, Labor, Model studies, Projection, Prediction, Forecasting.

The various significant uncertainty variables that affect the duration of an activity while it in progress, and in turn, affect the project completion time are examined. The Project Duration Forecasting Model PRODUF simulates and combines the impact of the significant uncertainty variables and incorporates it in the activity duration estimates as it revises them. PRODUF was used successfully to estimate completion dates for a dam construction project by using weather productivity relationships and data on workday type (holiday, half workday, full workday, or double shift). Limitations of the model include using only three reporting periods for considering uncertainty variables, questionable accuracy of historical input data, and lack of any statistical analysis to quantify the impact of the uncerrtainty variables. (Geiger-PTT)
W86-04620

RISK PENALTY FUNCTIONS FOR HAZARDOUS WASTE MANAGEMENT,
Notre Dame Univ., IN. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5G.
W86-04644

6B. Evaluation Process

LARGE-SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL ISSUES,
United Nations Environment Programme, Nairobi (Kenya).
G. N. Golubev, and A. K. Biswas.
IN: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 1-5, 1 tab, 5 ref.

Descriptors: *Planning, *Evaluation, *Water transfer, *Water supply, *Water policy, Interbasin transfer, Environmental effects, Social aspects, Institutional constraints, Political constraints, Water law, Water resources development, Diversion, Water management.

Increasing water withdrawals throughout the world are leading to a new generation of water transfer projects. Unlike the small, local projects implemented to date, future transfers will tend towards large-scale, border-spanning projects with significant institutional, environmental and social issues. A framework is given to evaluate existing and planned projects. The following questions are asked. (1) Is water transfer an inevitable strategy. (2) Under what conditions is it the most efficient of alternative strategies. (3) What institutions (laws, policies, administrative structures) favor or impede implementation of water transfer strategies. (4) What trade-offs must be considered in decisions relating to water transfers. The importance of continuous monitoring and evaluation is stessed so that timely corrective actions can be taken during implementation of the project. (Cassar - PTT)
W86-03949

WATER TRANSFER IN CHINA: THE EAST ROUTE PROJECT,
L. Changming, Z. Dakang, and X. Yuexian.
In: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 103-118, 5 fig, 3 tab, 11 ref.

Descriptors: *Planning, *Evaluation, *Water transfer, Interbasin transfer, Diversion, Rivers, Canals, Grand Canal, Economic aspects, Water supply development, China, Swamps, Drainage, Irrigation, Water management.

The East Route is the planned first stage of a three-stage project to transfer water from the south of China to the north. This scheme uses the ancient Grand Canal to carry water northward from the Jiangdu pumping station to Tianjin. The average annual transfer would be 14 billion cu m, with about 30 billion cu m being transferred in dry years. Expected benefits of the East Route are expansion or improvement of about 4.3 million ha of irrigated land, 2.7 billion cu m of water available for municipal and industrial use, moderization of navigation on the canal, and drainage of water from waterlogged fields. The main disadvantage of the East Route is the power required to lift the water 65 m. Based on experiences with the Grand Canal and with water transfer projects in North Jiangsu, the East Route portion of the project was approved. Public attitudes are generally positive. (Cassar - PTT)
W86-03954

WATER TRANSFER IN A SMALL COUNTRY: HUNGARIAN EXPERIENCES AND PERSPECTIVES,
L. David.
In: Large Scale Water Transfer: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 135-156, 11 fig, 1 tab, 16 ref.

Descriptors: *Planning, *Evaluation, *Water transfer, Interbasin transfer, Environmental effects, Hungary, Tisza River, Water resources development, Water supply development, Water management.

The water transfer experiences in Hungary were analyzed. The stage of river basin development is an important factor in planning transfer projects. A formula is given for calculating a development function (D). The higher the development stage, the more necessary is water transfer. For example, calculated development functions are Tisza Valley, 38%; Danube Valley, 36%; and Hungary as a whole, 37%. In this range, water transfers are feasible but not vital. A development function is also calculated for the eutrophied Lake Balaton. The history of development and water projects in the Tisza Valley is described. The first water transfer project was completed in 1956. It transferred raw water from the Tisza to the Koros River valley. Additional canals were constructed in subsequent years. Several recommendations were developed from these experiences. (1) Water transfer should be analyzed in connection with the degree of river basin development. (2) Water transfer projects should be integrated into the overall water management system of the basin. (3) Water transfer activity should be evaluated using multicriterion decision analysis method. (4) When capital resources are limited, gradual development of water transfer projects is desirable. (5) Environmental monitoring is a vital part of a transfer project. The goal should be development of a new equilibrium between the project and its environment. (Cassar - PTT)
W86-03956

BRAHMAPUTRA RIVER BASIN DEVELOPMENT,
A. H. Khan, and S. Miah.
IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 85-98, 4 fig, 16 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *India, *Bangladesh, Economic aspects, International agreements, Water policy, Water management, Brahmaputra River, Irrigation, Flood control, Water storage, Dams, Reservoirs, Storage, Saline intrusion, Hydroelectric power.

The geographical features and hydrology of the Brahmaputra River and its basin (total, 234,000 sq miles) are described. Rising in the Himalayas, it flows 1800 miles to the Bay of Bengal at Bangladesh. The river is an important resource for Bangladesh, supplying drinking, municipal, and irrigation water; controlling saline intrusion; serving as a navigation system; and providing fish. Development in the Brahmaputra basin is necessary for flood control, irrigation in the dry season, prevention of saline intrusion from the Bay of Bengal, and improvement of transportation and navigation channels in thus rural region. Development to date consists of the following: in India--(1) flood control works which include 2380 miles of embankments, 480 miles of drainage channels, and 44 town pro-

tection schemes, (2) minor irrigation works which provide water to 1.5 million of the 7.7 million cultivable acres; in Bangladesh--(1) flood control works which include 135 miles of embankments, in addition to channel improvement and drainage, (2) irrigation works for about 1 million acres. The importance of cooperative river basin development is emphasized. One solution to the problems of flood control and irrigation is construction of storage dams in the mountains of India. However, studies show that storage reservoirs would hold only 7% of the potential storage of the basin. A major consideration in this region is seismic activity. An estimated 113 million KW of hydropower exists in the Tibetan plateau section of the basin. (Cassar - PTT)
W86-03963

GANGES BASIN DEVELOPMENT: A LONG-TERM PROBLEM AND SOME SHORT-TERM OPTIONS,
For primary bibliographic entry see Field 6E.
W86-03964

METHOD FOR RANKING BIOLOGICAL RESOURCES IN OIL SPILL RESPONSE PLANNING,
National Coastal Ecosystems Team, Slidell, LA.
J. K. Adams, A. J. Heikamp, and R. P. Hannah.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas, p 159-164, 1 fig, 4 tab, 7 ref.

Descriptors: *Oil spills, *Cleanup operation, *Planning, *Environmental effects, Oil pollution, Mapping, Oil.

A method for identifying and ranking biologically important geographic areas in spill response planning is described. Although this project was conducted to minimize environmental risks due to accidental spillage from the Louisiana Offshore Oil Port (LOOP), the methodology is widely applicable. The method has three important characteristics: it is driven by the existing information base and easily updated, applicable to all coastal and aquatic environments, and capable of producing a list of priorities within a specific spill response planning area. The rationale of selecting ranking units and ranking criteria is presented. Habitat was selected as the best available ranking unit for oil spill response planning. 'Habitat' is defined, and the attributes of habitats that make them useful analytical units are described. The ranking criteria selected (habitat recovery, persistence of oil, cleanup damage, important species supported, and habitat rarity) are defined and their evaluation explained. An application of the method is described for the LOOP spill response planning area. Habitats are identified and delineated, and values are assigned to the ranking criteria. The resultant habitat ranking is presented with recommendations for the incorporation of this analysis into a comprehensive oil spill contingency plan using a computerized geographic information system. (Author's abstract)
W86-04017

MIRG ENVIRONMENTAL ELEMENT: AN OIL SPILL RESPONSE PLANNING TOOL FOR THE GULF OF MEXICO,
ARCO Oil and Gas Co., Bakersfield, CA.
For primary bibliographic entry see Field 5G.
W86-04019

OIL SPILL PROTECTION PLANNING FOR NATURAL RESOURCES IN OREGON,
Oregon State Dept. of Environmental Quality, Corvallis.
For primary bibliographic entry see Field 6A.
W86-04020

HASBAH 6: OIL COMPANIES RESPONSE TO OIL POLLUTION IN THE ARABIAN GULF,
Gulf Area Oil Companies Mutual Aid Organization, Manama (Bahrain).
P. B. Ryan.
In: Proceedings of the 1983 Oil Spill Conference (Prevention, Behavior, Control, Cleanup), American Petroleum Institute, February 28-March 3, 1983, San Antonio, Texas. p 371-375.

Descriptors: *Oil spills, *Oil pollution, *Cleanup techniques, Arabian Gulf, Saudi Arabia, Oily water, Oil, Hasbah 6, Case studies.

The Hasbah 6 well offshore Saudi Arabia blew out on October 2, 1980 and remained out of control for ten days. The oil which escaped from the well during this period formed a large slick which drifted south-east down the gulf, threatening the coastal areas of all states south of the blowout site. Oil spill countermeasures were mounted by several oil companies in the region either on their own initiative or upon direction from their respective states' governments in attempts to minimize the adverse effects of the spill. All of the oil companies known to be involved in responding to the oil spill were members of the Gulf Area Oil Companies Mutual Aid Organization (GAOCMAO), an organization formed in 1972 to promote cooperation among oil companies in the Arabian Gulf for oil pollution control and cleanup in the region. The Hasbah 6 incident served to demonstrate the value of GAOCMAO in facilitating cooperative responses by member companies to a common pollution hazard and highlighted many of the problems likely to be encountered in mounting a spill cleanup operation of this magnitude in a restricted and multi-national environment such as the Arabian Gulf. (Author's abstract)
W86-04029

EXPECTED UTILITY, BENEFIT, AND LOSS CRITERIA FOR SEASONAL WATER SUPPLY PLANNING,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzystofowicz.
Water Resources Research WRERAO, Vol. 22, No. 3, p 303-312, March 1986. 6 fig, 4 tab, 38 ref, 2 append. NSF Grant No. CEE-8300928.

Descriptors: *Water supply planning, *Irrigation practices, *Seasonal variation, Cost-benefit analysis, Benefits, Management planning.

State-of-the-art decision criteria for seasonal water supply planning under uncertainty, with particular focus on irrigation supply, is discussed. Reviewed, compared, and contrasted, are three types of criterion functions: a utility function, a benefit function, and an opportunity loss function. Economic and preferential conditions imbedded in each function are identified. Theoretical relationships between these functions are established and illustrated using real data. The result of this synthesis is a methodological framework that unifies the three types of functions and offers analysts a systematic approach to choosing an appropriate decision criterion. (Lantz-PTT)
W86-04193

OPTIMAL WATER SUPPLY PLANNING BASED ON SEASONAL RUNOFF FORECASTS,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
R. Krzysztofowicz.
Water Resources Research WRERAO, Vol. 22, No. 3, p 313-321, March 1986. 10 fig, 3 tab, 23 ref. NSF Grant No. CEE-8300928.

Descriptors: *Water supply planning, *Seasonal runoff, *Runoff forecasting, *Optimum development plans, Markov Process, Model studies, Value, Dynamic programming.

Suppose a commitment of water supply for forthcoming season must be made within a prior period during which a sequence of seasonal runoff volume forecasts is available. The decision maker's dilemma is that on the average, the accuracy of forecasts increases with time, but the benefit from the supply allocation decreases as the commitment is delayed. This planning problem is modeled as a Markovian stopping process with maximization of the expected utility of outcomes as the planning criterion. The optimal decision strategy, obtained via dynamic programming, prescribes the timing of the commitment and volume of the planned supply as a function of forecasts. The strategy takes explicitly into account uncertainties in the forecasts, value of water (economic or subjective), risk attitude of the decision maker, and utility reduction factor caused by delaying the commitment. An extensive numerical example illustrates the capabilities of the model as an aid to real-time decision making and evaluation of the economic worth of forecasts. (Author's abstract)
W86-04194

RIVER RECREATION EXPERIENCE OPPORTUNITIES IN TWO RECREATION OPPORTUNITY SPECTRUM (ROS) CLASSES,
Minnesota Univ., St. Paul.
D. C. Wollmuth, J. H. Schomaker, and L. C. Merriam, Jr.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 851-857, October 1985. 2 fig, 3 tab, 28 ref.

Descriptors: *Wilderness areas, *Recreation, *Management planning, Surveys, Colorado River, Arkansas River, Public waters.

Different classes of the ROS system (the U.S. Forest Service and Bureau of Land Management method of inventorying, classifying, and managing wildlands) from the Colorado and Arkansas Rivers of Colorado were compared, using visitor survey data collected in 1979 and 1981, to see if the different classes offered different recreational experience opportunities. No differences between classes were found. Six possible reasons for this lack of difference are discussed, as follows: (1) recreation setting is not linked with experience (basic assumption violated); (2) improper classification of areas; (3) poor measurement of experience opportunities; (4) difference between studied riversegments was insignificant, despite correct assignment to different ROS classes; (5) a river recreation opportunity spectrum does not exist; and (6) information is lost in the process of classifying a multidimensional complex phenomenon into unidimensional, ordinal classes. The usefulness of ROS at the broader levels of planning and the needs at more detailed levels of planning are noted. (Rochester-PTT)
W86-04536

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

CHANG JIANG DIVERSION PROJECT: AN OVERVIEW OF ECONOMIC AND ENVIRONMENTAL ISSUES,
International Food Policy Research Inst., Washington, DC.
For primary bibliographic entry see Field 6D.
W86-03932

SIMULTANEOUS EQUATION DEMAND MODEL FOR BLOCK RATES,
Arizona State Univ., Tempe. Dept. of Economics.
For primary bibliographic entry see Field 6D.
W86-04155

RISK COSTS FOR NEW DAMS: ECONOMIC ANALYSIS AND EFFECTS OF MONITORING,
Stanford Univ., CA. Dept. of Industrial Engineering.
M. E. Pate-Cornell, and G. Tagaras.
Water Resource Research WRERAO, Vol. 22, No. 1, p 5-14, January 1986. 1 fig, 8 tab, 44 ref. NSF Grant PFR-7815898.

Descriptors: *Risks, *Dams, *Cost analysis, *Monitoring, Dam failure, Dam stability, Auburn Dam, Teton Dam, Dickey-Lincoln School Project, Warning systems.

Presented are new developments and illustrations of the introduction of risk and costs in cost-benefit analysis for new dams. The emphasis is on a method of evaluation of the risk costs based on the structure of the local economy. Costs to agricultural property as well as residential, commercial, in-

dustrial, and public property are studied in detail. Of particular interest is the case of sequential dam failure and the evaluation of the risk costs attributable to a new dam upstream from an existing one. Three real cases are presented as illustrations of the method: the Auburn Dam, the Dickey-Lincoln School Project, and the Teton Dam, which failed in 1976. This last case provides a calibration tool for the estimation of loss ratios. For these three projects, the risk-modified benefit-cost ratios are computed to assess the effect of the risk on the economic performance of the project. The role of a warning system provided by systematic monitoring of the dam is analyzed: by reducing the risk cost, the warning system attenuates their effect on the benefit-cost ratio. The precursors, however, can be missed or misinterpreted: monitoring does not guarantee that the risks to human life can be reduced to zero. this study shows, in particular, that it is critical to consider the risk costs in the decision to build a new dam when the flood area is large and densely populated. (Author's abstract)
W86-04156

REDUCED PRESSURE IRRIGATION INVESTMENT ECONOMICS,
South Dakota State Univ., Brookings. Dept. of Economics.
D. C. Taylor.
Water Resources Research WRERAO, Vol. 22, No. 2, p 121-128, February 1986. 7 tab, 28 ref.

Descriptors: *Reduced pressure irrigation, *Economic evaluation, Energy conservation, Irrigation efficiency, Water conservation, Crop yield, Cost analysis.

Because reduced pressure irrigation is energy saving, many commentators conclude that is also cost saving. The validity of this proposition is examined in this article. A central focus is whether yields are likely to be less with reduced pressure. If yields are not likely to be less and the purchase of a new irrigation system is expected to be profitable, clearly, a reduced pressure unit should be selected. If a yield reduction is not in prospect and the conversion of an existing conventional high pressure system to reduced pressure is contemplated, the decision revolves around the present value of the prospective annual energy cost savings from reduced pressure (the break-even investment) relative to a dealer's cost for making the conversion. the article also shows that even small reductions in yield from reduced pressure irrigation (e.g., less than 5%) can completely erode the economics of investing in reduced pressure units. (Author's abstract)
W86-04166

SHARING REGIONAL COOPERATIVE GAINS FROM REUSING EFFLUENT FOR IRRIGATION,
Hebrew Univ., Rehovoth (Israel). Center for Agricultural Economics Research.
A. Dinar, D. Yaron, and Y. Kannai.
Water Resources Research WRERAO, Vol. 22, No. 3, p 339-344, March 1986. 1 fig, 4 tab, 30 ref. BARD Grant No. I-101-79.

Descriptors: *Impaired water use, *Irrigation, *Cooperatives, *Cost-benefit analysis, Cost sharing, Effluents, Income distribution, Israel.

The allocation of cost and benefits from regional cooperation, with respect to reuse of municipal effluent for irrigation at the Ramla region of Israel, is discussed. An efficient regional solution provides the maximal regional income which has to be redistributed among the town and several farms. Different allocations based on marginal cost pricing and schemes from cooperative game theory like the core, Shapley value, and nucleolus are applied. The town and farm A have the main additional gains according to all allocation schemes presented. Advantages and disadvantages of these allocations schemes are examined in order to suggest a fair and acceptable allocation of the regional cooperative gains. Although no method has been preferred, the marginal cost pricing was found to be unacceptable by the participants. The conclusion is that the theory of cooperative games may provide guidelines while comparing the different solutions. (Lantz-PTT)
W86-04197

MULTIPLE COMPLETION MONITOR WELLS,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 4B.
W86-04207

COST GAP METHOD AND OTHER COST ALLOCATION METHODS FOR MULTIPURPOSE WATER PROJECTS,
Katholieke Univ. Nijmegen (Netherlands). Mathematisch Inst.
T. S. H. Driessen, and S. H. Tijs.
Water Resources Research WRERAO, Vol. 21, No. 10, p 1469-1475, October 1985. 3 fig, 4 tab, 29 ref, 1 append.

Descriptors: *Water resource projects, *Cost allocation, *Game theory, Separable costs, Nonseparable costs, Mathematical analysis.

Four different cost allocation methods are compared that allocate the joint costs of water resources projects among their participants on the basis of separable and nonseparable costs. These are: the egalitarian nonseparable cost (ENSC) method, the separable costs remaining benefits (SCRB) method, the minimum costs remaining savings method, and a new method, called the nonseparable cost gap method, which is derived from the tau value, a game-theoretical concept. All the methods except the ENSC method can be described with the aid of lower and upper bounds for the core of the involved cost game. For convex cost games, these three methods use the same bounds for the core and hence coincide, but their cost allocation does not belong necessarily to the core. For a second class of cost games called one-convex cost games, all methods except the SCRB method coincide, and their cost allocation is the center of gravity of the core of the involved cost game. (An appendix includes a proof that convex cost games are semiconvex.) (Author's abstract)
W86-04543

SIMULATION MODEL TO FORECAST PROJECT COMPLETION TIME,
Technical Univ. of Nova Scotia, Halifax. Faculty of Engineering.
For primary bibliographic entry see Field 6A.
W86-04620

6D. Water Demand

LONG-DISTANCE WATER TRANSFER: A CHINESE CASE STUDY AND INTERNATIONAL EXPERIENCES.
United Nations Univ., Tokyo (Japan).
Water Resources Series, Volume 3, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. Edited by Asit K. Biswas, Zuo Dakang, James E. Nickum and Liu Changming. 417 p.

Descriptors: *Water transfer, *Diversion, *Canals, *Irrigation, *China, Water supply, Water supply development, Economic aspects, Environmental effects, Water storage, Water conveyance, Atmospheric water.

Because of the increased need for irrigation in many nations, all viable sources of water are being developed. Long-distance water transfer is investigated as a serious means of making existing projects more efficient. A specific water transfer project that is discussed in detail is the proposed south-north program in eastern China. Areas of concern include: land use, crop allocation, environmental implications, water balance, groundwater, atmospheric moisture balance, saltwater intrusion, and soil characteristics. Water transfer projects in Egypt, Texas, Japan, and Pakistan are also included. (Halterman-PTT)
W86-03918

LONG-DISTANCE WATER TRANSFER: PROBLEMS AND PROSPECTS,
Biswas and Associates, Oxford (England).
A. K. Biswas.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experience, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 1-13, 2 tab, 12 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Irrigation, Agriculture, Industrial water, Water use, Developing countries, Economic aspects, Engineering, Canals, Diversion.

Aspects of the large-scale artificial mass transfer of water from a water-surplus to a water-deficient region for the purpose of furthering economic development, are discussed. This water transfer can be achieved by diverting the course of a river, or by constructing a large canal. Feasibility studies must include social and environmental costs along with engineering and economic factors. The major variables to be considered are: the physical system (including water quality and quantity, land implications, and atmosphere); the biological system (aquatic and land-based life); and the human system (including uses of the water produced and socio-cultural costs). The proposed North American Water and Power Alliance (which would transfer water primarily from Canada to the United States and Mexico) is described and its problems and prospects are discussed. It is pointed out that secondary and tertiary benefits and costs of such a system should also be considered. It is essential that case studies from a few interregional water transfer projects in existence be prepared in order that certain generalized conclusions can be drawn. (Halterman - PTT)
W86-03919

RIVER NILE: MAIN WATER TRANSFER PROJECTS IN EGYPT AND IMPACTS ON EGYPTIAN AGRICULTURE,
Water Research Centre, Cairo (Egypt).
M. Abu-Zeid.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 15-34, 2 fig, 1 tab, 9 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *Irrigation, *Egypt, *Nile River, Agriculture, Dams, Canals, Economic aspects, Water use.

The River Nile is described, and Egypt's major water transfer projects along the Nile are considered. A history of Nile River water transfer projects (beginning in 2400 BC) is presented, including the Ismailia Canal (built in 1862 and connecting the Nile and the Suez Canal) and the Ibrahimia Canal (built in 1873 and irrigate Middle Egypt all year round). The effects of each of the projects on agriculture and on economic development are considered. The Aswan High Dam (construction completed in 1970) is described in detail. The impact of the dam on agriculture, on the impact of the dam on fisheries, are among the topics considered. The benefits of land reclamation projects, including the enlargement of the Ismailia Canal, the West Nubaria Canal System, and the El Salam Canal, are described. The major constraints to Egyptian agriculture today are lack of on-farm water management, waterlogging and salinity, and the need for improved irrigation systems. (Halterman - PTT)
W86-03920

AGRICULTURAL WATER MANAGEMENT AND THE ENVIRONMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
G. V. Skogerboe.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 35-64, 6 fig, 1 tab, 17 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Irrigation, *Pakistan, Salinity, Waterlogging, Agriculture, Water quality, Indus River.

The importance of irrigation in water management practices is emphasized, and the two major irrigation problems encountered (salinity and waterlogging of the soil) are described. Also discussed are difficulties involved in maintaining the appropriate water quantity and quality in irrigation systems are also discussed. An irrigation system is defined, its three major components (the farm subsystem, the water delivery subsystem, and the water removal subsystem) are described, and the legal, practical and social problems encountered in the administration of such a system are considered. The majority of water quality planning efforts in irrigated agriculture are directed toward identifying measures required to control salinity. The three steps involved in river basin salinity planning are: evaluation of alternatives for each area, optimizing cost-effectiveness relationships from individual areas into a single cost-effectiveness relationships from individual areas into a single strategy, and assigning the required level of salinity control that should be implemented in each irrigated area. The process involved in the development of solutions for improving existing irrigated lands is described. The Indus Basin irrigation system in Pakistan is presented as an example of the use of this development process. (Halterman - PTT)
W86-03921

JAPANESE WATER TRANSFER: A REVIEW,
Iwate Univ., Morioka (Japan). Faculty of Agriculture.
M. Okamoto.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 65-75, 1 fig.

Descriptors: *Water transfer, *Water supply, *Irrigation, *Japan, Water use, Economic aspects, Diversion, Water supply development, Industrial water.

Interregional water transfer has become increasingly important in Japan in recent years, although the projects are all on a relatively small scale. The problems faced in the Japanese projects, including technical, socio-economic, institutional and environmental, are discussed. Several steps for planning and executing these projects are outlined. They include: examine all possible alternatives to determine the necessity; examine advantages and disadvantages associated with various routes available; plan the operation of the project to minimize conflicts of interest between different sectors; and carefully examine all potential negative effects. (Halterman - PTT)
W86-03922

TEXAS WATER SYSTEM: IMPLICATIONS FOR ENVIRONMENTAL ASSESSMENT IN PLANNING FOR INTERBASIN WATER TRANSFERS,
Indiana Univ. at Bloomington. Dept. of Geography.
C. Greer.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 77-90, 2 fig, 10 ref.

Descriptors: *Water transfer, *Texas, Water supply, Water supply development, Irrigation, Agriculture, Water use, Canals, Diversion, Environmental effects.

The Texas Water System proposal, developed during the 1960's and 1970's, is described. The key to the system is a series of reservoirs on the major rivers of east and central Texas which drain into the Gulf of Mexico. The role of these reservoirs would be to store water prior to conveyance through two major canal systems: The Coastal Canal System and the Trans-Texas Canal System. The wide range of potential environmental impacts in large interbasin transfers are discussed. They include those impacts in the exporting basin, those along the routes of conveyance, and those in the areas of delivery. The need for balanced environmental planning of the proposed transfer scheme is stressed. (Halterman - PTT)
W86-03923

CHINA'S SOUTH-TO-NORTH WATER TRANSFER PROPOSALS,
Academia Sinica, Beijing (China). Inst. of Geography.
Z. Dakang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 91-96.

Descriptors: *Water transfer, *China, Water supply, Water supply development, Irrigation, Agriculture, Industrial water, Water use, Diversion.

Because of the south-north water imbalance in China, and projected future water shortages in the north, the water conservancy department carried out some studies on northward water diversion from the various reaches of the Chang Jiang River. The history of the planning and development of that diversion from the early 1950s through the early 1980s are outlined. This discussion serves as an introduction to a series of papers delivered at a conference concerned with the many environmental aspects of the development and implementation of such a vast diversion project. (Halterman-PTT)
W86-03924

NATURAL CONDITIONS IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
W. Zhongyi, and Z. Chunian.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 97-114, 5 ref.

Descriptors: *Diversion, *Water transfer, *Water supply, *Geomorphology, *China, Climatic data, Precipitation, Rivers, Hydrology, Soil types.

The land area included in a south-north water transfer in eastern China is described. Background, or baseline, conditions are outlined. Geomorphological features; climatic conditions, including temperature and precipitation; rivers and hydrologic characteristics; hydrogeological conditions; and soil and vegetation types and properties are emphasized. (Halterman - PTT)
W86-03925

LAND USE AND CROP ALLOCATION IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
G. Huancheng, and X. Zhikang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 115-125.

Descriptors: *Water use, *China, *Diversion, *Water transfer, Water supply development, Canals, Economic aspects, Environmental effects.

Background information on land use and crop distribution, both historically and presently, in the region of a proposed water transfer in China, is provided. Existing problems in land use and crop allocation are discussed, and means for improvement are presented. The worst problems are due to drought conditions interspersed with excess surface water. Other serious problems are soil salinization and oversimplified crop structure. Increased use of available water sources, such as wells, providing sufficient drainage, and multiple cropping, are detailed, and the incorporation of these factors into the planning of the water transfer project is discussed. (Halterman - PTT)
W86-03926

SOUTH-NORTH WATER TRANSFER PROJECT PLANS,
Ministry of Water Conservancy and Power, Beijing (China).
Y. Bangyi, and C. Qinglian.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 127-149, 7 fig, 3 tab.

Descriptors: *Water transfer, *Water use, *Diversion, *China, Water supply, Water supply development, Canals, Economic aspects, Environmental effects.

Various aspects of the projected south-north water transfer program in China are discussed. Specific areas covered are the distribution of water and land resources in China, including distribution of precipitation, distribution of stream runoff, groundwater resources; the utilization of water resources in China, water needs at the end of this century, current status of major rivers in eastern China and future trends in development; and planning and research on the water transfer program. Transfer route schemes, projects for storage and regulation, and project benefits are also outlined. (Halterman - PTT)
W86-03927

ENVIRONMENTAL IMPLICATIONS OF WATER TRANSFER,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
R. Herrmann.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 151-158, 12 ref.

Descriptors: *Water transfer, *Water use, *Diversion, *Environmental effects, *China, Water supply, Canals, Water supply development.

A south-north water transfer project being planned for eastern China would impact upon a variety of aspects of the environment. Particular focus is on the impact of withdrawal of water on the aquatic environment, the impact of water transfer on adjacent terrestrial and freshwater ecosystems, and environmental impacts of irrigation development. Techniques for optimizing the water transfer, including models of cause-effect relationships between different hydraulic engineering measures and their environmental impacts, are discussed. (Halterman - PTT)
W86-03928

IMPACT OF WATER TRANSFER ON THE NATURAL ENVIRONMENT,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6G.
W86-03929

IMPACT OF SOUTH-TO-NORTH TRANSFER UPON THE NATURAL ENVIRONMENT,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6G.
W86-03930

INSTITUTIONS AND CHINA'S LONG-DISTANCE WATER TRANSFER PROPOSALS,
Cornell Univ., Ithaca, NY. Dept. of Asian Studies.
J. E. Nickum.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 181-191, 23 ref.

Descriptors: *Water transfer, *Water use, *Diversion, *China, Water supply, *Legal aspects, Water supply development, Canals, Environmental effects, Economic aspects.

One of the most arduous tasks related to the south-north water transfer project in China is the design-

ing, or adapting, of regulations to be used to allocate the water. Water rights, relations between provinces, and irrigation management are areas of special interest in this regard. These considerations are critical to making a realistic assessment of likely deleterious impact of the introduction of new water via a mass transfer and to drawing up the institutional reforms necessary to mitigate such harmful side effects, most notably the spread of secondary salinization due to excess application and improper drainage. (Halterman - PTT)
W86-03931

CHANG JIANG DIVERSION PROJECT: AN OVERVIEW OF ECONOMIC AND ENVIRONMENTAL ISSUES,
International Food Policy Research Inst., Washington, DC.
B. Stone.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 193-214, 1 tab, 32 ref.

Descriptors: *Water transfer, *Water use, *Environmental effects, *Diversion, *China, Water supply development, Water supply, Irrigation, Canals, Wells.

A proposed south-north water transfer project in China is discussed and several economic and environmental issues are outlined. Limnological deterioration and general problems of water pollution, impacts on aquatic production, lowering of the Chang Jiang estuary, and flooding and salinization of soils are key environmental problems. The trends in China's supply and demand for foodgrains, emerging issues in water requirement trends, grain production progress in North China, development of wells and the North China water table, alternative irrigation schemes in North China, alternative approaches to irrigation development, and the development of information resources are also issues that must be considered in the overall planning of the project. (Halterman - PTT)
W86-03932

WATER BALANCE IN THE WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
L. Changming, and L. Enbao.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 215-232, 7 fig, 5 tab, 1 ref.

Descriptors: *Diversion, *Water supply development, *Environmental effects, *Water transfer, *China, Economic aspects, Canals, Water supply.

The water balance in the proposed water transfer region of eastern China and the four major river basins associated with it, are analyzed. The major emphasis of the analysis is on areal distribution of water balance elements, (precipitation, runoff, evaporation, soil moisture renewal); characteristics of water-balance elements in the main provinces and autonomous region; and the temporal distribution of water balance elements. Some specific problems associated in balancing water supply and requirements include water supply analysis, water requirement analysis, and water balance and ecological equilibrium. (Halterman - PTT)
W86-03933

INTEGRATED EVALUATION OF THE SURFACE AND GROUNDWATER RESOURCES OF THE HAI AND LUAN HE BASINS,
Academia Sinica, Beijing (China).
L. Jiasan.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 233-243, 2 fig, 1 tab.

Descriptors: *Diversion, *Water transfer, *Water use, *Water supply, *China, Canals, Irrigation, Groundwater, Water supply development.

As part of the assessment of a potential water transfer project in eastern China, the surface and groundwater resources of the Hai and Luan He Basins are evaluated. The characteristics of the calculated basin stream runoff formation and the mutual recharge relationships between surface and groundwater are outlined. River runoff and composition of water resources in the basin, estimation of basin water resources, hydrological balance, and sources of plains groundwater recharge are also discussed. (Halterman - PTT)
W86-03934

PRELIMINARY ESTIMATION OF NATURAL RUNOFF IN THE HUAI HE BASIN,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2A.
W86-03935

SHALLOW GROUNDWATER RESOURCES OF THE HUANG-HUAI-HAI PLAIN,
For primary bibliographic entry see Field 2F.
W86-03936

POTENTIAL EVAPORATION AND FIELD WATER CONSUMPTION IN THE NORTH CHINA PLAIN,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2D.
W86-03937

ANALYSIS OF STORAGE FOR THE REGULATION OF SURFACE WATER IN THE HUANG-HUAI-HAI PLAIN FOR SOUTH-TO-NORTH WATER TRANSFER,
Hebei Inst. of Geography, Shijiazhuang (China)
For primary bibliographic entry see Field 4A.
W86-03938

PROBLEM OF WATER SUPPLY IN THE HAI-LUAN PLAIN,
Academia Sinica, Beijing (China).
H. Rangtang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 309-319.

Descriptors: *Water transfer, *Water supply, *Water conveyance, *Water supply development, *China, Diversion, Canals, Irrigation, Economic aspects, Environmental effects, Water storage.

As part of the overall assessment of the proposed south-north water transfer in eastern China, a variety of controversial issues are addressed. The conclusions drawn from this investigation include: northern water sources cannot satisfy industrial and municipal requirements, and northern water sources cannot satisfy economic requirements. Although the project is very necessary to meet water needs, the transfer presents very formidable problems. First, the project is very expensive. Second, the returns to investment are not striking, because existing state-set prices for agricultural produce are relatively low, making it difficult to have a net increase in income from irrigating with interbasin water. Third, there is a significant danger of secondary salinization. As a supplement to the water transfer, thorough and rational use of local water sources is recommended. Means of attaining this goal include fully intercepting mountain runoff, promoting underground storage, and building reservoirs suited to local conditions. (Halterman - PTT)
W86-03940

SOME ASPECTS OF THE NECESSITY AND FEASIBILITY OF CHINA'S PROPOSED SOUTH-TO-NORTH WATER TRANSFER,
Ministry of Water Conservancy and Power, Beijing (China).
Y. Bangyi, and C. Chunhuai.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 321-331.

Descriptors: *Water transfer, *Water supply, *Diversion, *Irrigation, *China, Water supply development, Canals, Economic aspects, Environmental effects, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the feasibility and necessity of the project are scrutinized. Conclusions indicate that the project to transfer water from the Chang Jiang would provide a rich source of water to the north, but it would only be a supplemental measure. Thorough use of local water resources is also necessary. Any increase in the diversion of water from the Huang He onto the Hai He plain must be premised on satisfying the requirements of the river itself and guaranteeing the water use of irrigation districts which are now diverting the Huang He. Analysis of the economic rationality of the transfer project has been insufficient, and work must be increased in this area. With its extraordinarily broad scope this project requires consideration of benefits it would provide in the form of the conditions for the development of the other departments of the national economy. Finally, the impact of the water transfer on the environment must be treated cautiously, considering improvements and negative impacts. (Halterman - PTT)
W86-03941

ATMOSPHERIC MOISTURE BALANCE IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 2A.
W86-03942

EFFECT OF SOUTH-TO-NORTH WATER TRANSFER ON SALTWATER INSTRUSION IN THE CHANG JIANG ESTUARY,
For primary bibliographic entry see Field 6G.
W86-03943

INVESTIGATION OF THE WATER QUALITY AND POLLUTION IN THE RIVERS OF THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 5B.
W86-03944

POSSIBLE EFFECTS OF THE PROPOSED EASTERN TRANSFER ROUTE ON THE FISH STOCK OF THE PRINCIPAL WATER BODIES ALONG THE COURSE,
Wuhan Inst. of Hydrobiology (China).
For primary bibliographic entry see Field 6G.
W86-03945

EFFECT OF DIVERTING WATER FROM SOUTH TO NORTH ON THE ECOSYSTEM OF THE HUANG-HUAI-HAI PLAIN,
Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science.
For primary bibliographic entry see Field 6G.
W86-03946

EXPERIMENTAL STUDY OF IMPROVING THE SALINE-ALKALI SOIL IN THE YU-CHENG EXPERIMENTAL AREA, SHANDONG,
X. Yuexian, and Z. Xingquan.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 395-405, 6 fig, 1 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *Irrigation, *China, Soil moisture, Soil physical properties, Environmental effects.

As part of the overall assessment of the proposed south-north water transfer in eastern China, experiments were conducted on soil saline-alkali conditions. Measures for improving saline soil include pump wells, which lower the water table to allow increased percolation of rainwater; open channel drainage system, which increases surface water removal and therefore, the dissolved salts therein; developing soil fertility using organic fertilizers, which changes the soil structure and, therefore, increases soil porosity and moisture storing capacity; and, afforestation, which reduces wind, and increases drainage. These measures could help offset the impacts of the increased water resulting from the transfer. (Halterman - PTT)
W86-03947

LARGE SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL EXPERIENCES.
United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6E.
W86-03948

LARGE-SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL ISSUES,
United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6B.
W86-03949

INTER-BASIN WATER DIVERSION: CANADIAN EXPERIENCES AND PERSPECTIVES,
Victoria Univ. (British Columbia). Dept. of Geography.
For primary bibliographic entry see Field 6E.
W86-03950

INTER-BASIN WATER TRANSFERS IN THE UNITED STATES,
Western Michigan Univ., Kalamazoo. Dept. of Geography.
For primary bibliographic entry see Field 6E.
W86-03951

PARTIAL SOUTHWARD DIVERSION OF NORTHERN AND SIBERIAN RIVERS,
For primary bibliographic entry see Field 6G.
W86-03952

INTERREGIONAL WATER TRANSFERS IN MEXICO,
H. Garduno.
In: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England 1985. p 119-134, 7 fig, 5 tab, 3 ref.

Descriptors: *Planning, *Water supply, *Water demand, *Water transfer, Interbasin transfer, Mexico, Irrigation, Political constraints, Diversion, Institutional constraints, Economic aspects, Agriculture, Water management.

Water resources and use in Mexico are described. Four zones with similar or complementary requirements for water resources development actions are designated: Pacific, Northern, Central, and Gulf/Southeastern. Interregional water transfer supply the large population of Mexico City and the arable, but dry, farmland in the Noroeste region. Excessive groundwater mining in the Mexico City area indicates the need for more interbasin transfer to this area. In this country water decisions are made through the central government. Although the overall effect has been positive, local water transfer projects are usually rejected. (Cassar - PTT)
W86-03955

WATER TRANSFER IN A SMALL COUNTRY: HUNGARIAN EXPERIENCES AND PERSPECTIVES,
For primary bibliographic entry see Field 6B.
W86-03956

RIVER BASIN DEVELOPMENT: PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON RIVER BASIN DEVELOPMENT.
United Nations Development Programme.
For primary bibliographic entry see Field 6E.
W86-03957

SOME MAJOR ISSUES IN RIVER BASIN MANAGEMENT FOR DEVELOPING COUNTRIES,
For primary bibliographic entry see Field 6E.
W86-03958

IRRIGATION WATER REQUIREMENTS IN BANGLADESH,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
H. R. Khan.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 150-157, 1 fig, 5 tab, 2 ref.

Descriptors: *Planning, *Water demand, *Water resources development, *Developing countries, *River basins, *Bangladesh, Water policy, Water management, Ganges River, Brahmaputra River, Meghna River, Irrigation requirements, Saline intrusion, Water use, Water supply.

In Bangladesh there are conflicting demands for water supplies during the November to May dry season. Water is needed for agriculture, domestic, and industrial purposes, for maintaining river depths to allow adequate navigation, for avoiding damage to fisheries, and for limiting upland penetration of saline water. In the dry season flow for the four major rivers is 173.40 million acre feet (MAF). The water availability (in MAF) for January, February, March, and April, respectively, is 11.10, 9.20, 10.15, and 12.69. The irrigation requirements (in MAF) for the same months, respectively, are 11.7, 12.6, 17.27, and 12.75. Any further reduction in river flows or upstream diversion to increase water supply would greatly increase salinity in southern Bangladesh. (Cassar - PTT)
W86-03968

INTERNATIONAL WATER STATISTICS - SOME CONCLUSIONS,
Wasserwerke Wien (Austria).
For primary bibliographic entry see Field 7C.
W86-04150

WATER SUPPLY BY OPTIMAL MIXING OF WATERS OF VARIABLE QUANTITY AND QUALITY,
University of Petroleum and Minerals, Dhahran (Saudi Arabia).
For primary bibliographic entry see Field 5F.
W86-04154

SIMULTANEOUS EQUATION DEMAND MODEL FOR BLOCK RATES,
Arizona State Univ., Tempe. Dept. of Economics.
D. E. Agthe, R. B. Billings, J. L. Dobra, and K. Raffiee.
Water Resources Research WRERAO, Vol. 22, No. 1, p 1-4, January 1986. 3 tab, 14 ref.

Descriptors: *Simultaneous equations, *Model studies, *Rate structure, Cost analysis, Hausman test, Mathematical models, Tucson, Arizona, Costs.

Examined is the problem of simultaneous-equations bias in estimation of the water demand function under an increasing block rate structure. The Hausman specification test is used to detect the presence of simultaneous-equations bias arising from correlation of the price measures with the regression error term in the results of a previously published study of water demand in Tucson, Arizona. An alternative simultaneous equation model is proposed for estimating the elasticity of demand in the presence of block rate pricing structures and availability of service charges. This model is used to reestimate the price and rate premium elasticities of demand in Tucson, Arizona for both the usual long-run static model and for a simple short-run demand model. The results from these simultaneous equation models are consistent with a priori expectations and are unbiased. (Author's abstract)
W86-04155

IDENTIFICATION OF WATER DEMAND MODELS FROM NOISY DATA,
A.T. and T. Bell Labs., Inc., Middletown, NJ.
L. K. Kher, and S. Sorooshian.
Water Resources Research WRERAO, Vol. 22, No. 3, p 322-330, March 1986. 3 fig, 4 tab, 24 ref. DOE Grant No. DEAO 180 RA50256.

Descriptors: *Water demand, *Noisy data, *Model studies, Time series analysis, Regression analysis, Statistical models, Algorithms, Tucson, Arizona.

The identification of a proper water demand when all the variables are noisy is one of the major problems in the planning process. To date, this problem has been overlooked, and generally, regression or time series models have been used. It has been suggested that the existing methods to include noisy variables are fraught with problems such as nonidentifiability and unboundedness. An alternative procedure is proposed to identify a water demand model from a set of noisy data using noisy realization theory. A mathematical programming-based solution algorithm is developed to identify a first-order lag dynamical model for this noisy problem. This algorithm gives bounds on both the model parameters and on the noise covariance matrix. The unboundedness problem is addressed by using prior information about the upper bound on the noise covariance matrix. The monthly municipal water demand of Tucson, Arizona, from 1974 to 1977 is modeled as an example. The model assumes 10-30% noise in the variables and then correspondingly gives a range for each model parameter. (Lantz-PTT)
W86-04195

MUNICIPAL AND INDUSTRIAL WATER SUPPLY IN CIUDAD JUAREZ, MEXICO,
California State Univ., Fullerton. Dept. of Geography.
W. J. Lloyd, and R. A. Marston.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 841-849, October 1985. 7 fig, 3 tab, 24 ref.

Descriptors: *Water demand, *Population dynamics, *Mexico, *Industrial Development, *Groundwater, *Water table decline, *Salinity, Hueco Bolson, Aquifers, Simulation analysis, Arid zone, Water use, Forecasting, Groundwater mining, Municipal water.

Rapid industrialization and population growth in the north Mexican desert city of Ciudad Juarez are placing a serious strain on the city's municipal water resources. Water deliveries and service area have more than doubled over the past decade, and plans for additional expansion are being implemented. This expansion is already contributing to water table declines and salinity increases in the Mexican portion of the Hueco Bolson, the sole source of water for the city. Continued water mining of the limited fresh water reserves should produce serious water supply problems in the near future. New estimates of future water consumption incorporated into a digital aquifer simulation model indicate that these problems may appear much sooner than anticipated by previous investigations. The acceleration and spread of serious water problems is likely to affect both the integrity of the municipal water utility's resource base as well as the long-term productivity of private industrial wells located around the city's periphery. These problems are exacerbated because the thickness of freshwater deposits diminishes substantially in the portion of the Hueco Bolson lying southeast of the study area. (Peters-PTT)
W86-04535

6E. Water Law and Institutions

WATER FOR HUMAN CONSUMPTION, MAN AND HIS ENVIRONMENT: PROCEEDINGS OF THE 4TH WORLD CONGRESS OF THE INTERNATIONAL WATER RESOURCES ASSOCIATION (IWRA).
International Water Resources Association, Urbana, IL.
Water Resources Series Volume 6, 1983. September 5-9, 1982, Buenos Aires, Argentina. Edited by W. Hall and C. Maxwell. 167 p.

Descriptors: *Water law, *Water resources development, *Potable water, Rural areas, Hydrology, Developing countries, Resources development, Water supply development, Institutions, Environmental aspects, Social aspects, Economic aspects, Legal aspects, United Nations, Training, Egypt, China, Indonesia.

This report includes discussions and conclusions of several International Water Resources Association (IWRA) committees and special sessions working on the problem of water for human consumption. These committees were (1) water and systems engineering,(2) educational, economic and social aspects, (3) water resources and the environment, and (4) water law and administration. The special sessions topics included (1) UNICEF: non-agricultural uses of rural water, (2) IWRA committee on oceanic water resources, (3) flatlands hydrology and management, (4) Japan's water resources, (5) UNESCO'S international hydrological program, (6) the World Bank's role in water resources development, (7) the Interamerican Development Bank's role in water resources development, (8) the United Nation's role in water resources development, (9) the water resources of Egypt, China, and Indonesia, and (10) the Salto Grande Joint Technical Commission. (Cassar - PTT)
W86-03907

TRANSFERABILITY OF WATER RIGHTS IN SOUTH AUSTRALIA,
South Australian Dept. of Engineering and Water Supply, Adelaide.
H. T. Tuckwell.
June 1985. 35 p, 3 append.

Descriptors: *Water allocation, *Resource allocation, *Available water, *Australia, Hydrologic budget, Water conservation, Water use, Water demand, Water resource development, Water distribution, Water law, Water management, Irrigation.

Water resource management in South Australia is principally concerned with irrigation and other uses of the River Murray. The development of current transfer policies, the Northern Adelaide Plains underground water rights, and Bolivar effluent water rights are also discussed. Several case histories involving implementation are presented, including those pertaining to market value of water rights movement of water rights, mortgaged land, and anticipation of increased saline inflows to a river. In the field of water resource management, South Australia is developing and implementing measures to provide for the increased transferability of water rights to increase the availability of water to promote the liklihood of water being applied as efficiently as possible. (Halterman - PTT)
W86-03912

GUIDELINES ON COMMUNITY LOCAL FLOOD WARNING AND RESPONSE SYSTEMS.
Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.
For primary bibliographic entry see Field 6F.
W86-03913

INSTITUTIONS AND CHINA'S LONG-DISTANCE WATER TRANSFER PROPOSALS,
Cornell Univ., Ithaca, NY. Dept. of Asian Studies.
For primary bibliographic entry see Field 6D.
W86-03931

LARGE SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL EXPERIENCES,
United Nations Environment Programme, Nairobi (Kenya).
Water Resources Series, Volume 7, Tycooly Publishing Ltd.,: Oxford, England, 1985. Edited by Genady N. Golubev and Asit K. Biswas. 158 p.

Descriptors: *Planning, *Water policy, *Environmental effects, *Water transfer, *Water supply, Interbasin transfer, Social aspects, Economic aspects.

The environmental, economic, and social aspects of water transfer projects is emphasized in experiences from Canada, the U.S., Soviet Union, Sudan, China, Mexico, and Hungary. Although some countries have abundant water, it is often unevenly distributed. Examples are the arid western U.S. and the humid eastern U.S., the dry prairie provinces of Canada, and the water requirements of the large population concentrated in Mexico City. For developed river basins water transfer is the most feasible alternative in obtaining additional water supplies. The institutional and political constraints peculiar to each country are discussed. Central governmental control appears to favor large interbasin projects. In countries where public participation is encouraged, water transfer projects are often delayed or rejected on environmental or economic grounds. (Cassar - PTT)
W86-03948

LARGE-SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL ISSUES,
United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6B.
W86-03949

INTER-BASIN WATER DIVERSION: CANADIAN EXPERIENCES AND PERSPECTIVES,
Victoria Univ. (British Columbia). Dept. of Geography.
W. R. D. Sewell.
IN: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 7-35, 9 fig, 7 tab, 71 ref.

Descriptors: *Planning, *Political constraints, *Water transfer, Interbasin transfer, Canada, Diversion, Rivers, Reservoirs, Environmental aspects, Social aspects, Public opinion, Attitudes, North American Water and Power Alliance, Economic aspects, Water supply development, Water management.

Canada, a country of abundant water resources and very heavy water use, has implemented at least 60 interbasin water transfers as of 1980. Total flow is presently 4400 cu m/sec. These transfers have been widely accepted for several reasons: (1) small size of most transfer, (2) proximity of basins to each other, (3) lack of vigorous opposition by environmentalists. However, several proposed water transfers have generated considerable adverse reaction. Domestic schemes which have produced debate are the McGregor diversion (northern British Columbia); Aluminum Company of America Nechako River diversion; several diversions in the prairie provinces of Alberta, Saskatchewan, and Manitoba; and the James Bay scheme in Quebec. Proposals for water transfers from Canada to the U.S. are highly unpopular. The North American Water and Power Alliance scheme would divert water from rivers in Alaska and British Columbia to the western and southwestern U.S. This massive project would require construction of 240 reservoirs (highest dam, 1781 ft high; largest impoundment, 693 cu km), 112 irrigation systems, and 17 navigation channels. Several smaller schemes are also under discussion. Some concern the development of coal slurry pipelines. Studies on public reaction to international transfer show that most governmental personnel are lukewarm or totally opposed to any transfers. Environmentalists and native rights activists have been particularly vigorous in their opposition. Some Canadian citizens see water as a national resource rather than a continental resource. Finally, an increasing number of Americans are also opposed to international transfer. (Cassar - PTT)
W86-03950

INTER-BASIN WATER TRANSFERS IN THE UNITED STATES,
Western Michigan Univ., Kalamazoo. Dept. of Geography.
P. P. Micklin.
IN: Large Scale Water Transfers; Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 37-65, 8 fig, 2 tab, 62 ref.

Descriptors: *Planning, *Political constraints, *Water transfer, Interbasin transfer, Diversion, Rivers, Reservoirs, Environmental aspects, Social aspects, Public opinion, Attitudes, North American Water and Power Alliance, Economic aspects, Water supply development, Water policy, Institutional constraints, Irrigation, Texas Water Plan, California State Water Project, Water conservation, Water supply, Legal aspects, Water use efficiency, Water management.

The water crisis in the western U.S. has stimulated interest in increasing supply by large-scale, long-distance transfer. However, the concern for the environment and the huge cost of these projects has put them several decades into the future. The State Water Project in California is the only major interbasin transfer to have been constructed in the U.S. Built between 1960 and 1973 at a cost of $2.3 billion, it diverts 4 cu km/yr from the north of the state to the south. The gigantic North American Water and Power Alliance, which would divert southward large quantities of water from Canada and the northwest U.S., is unlikely to be implemented. The Texas Water Plan, not likely to be constructed in the near future, would divert water from the eastern part of the state and from the Mississippi to western Texas and New Mexico. A $20 billion scheme was proposed to supply the High Plains with 13.5 cu km of water from the Missouri River or other Mississippi River tributaries. Institutional, legal, and political considerations play a major role in implementing large interbasin water transfers. The National Environmental Policy Act requires federal agency sensitivity to environmental protection and the preparation of impact statements. Alternatives to large water transfers are water conservation, improvement of water use efficiency, price increases, and augmentation of supply by nondiversion methods (flow regulation, desalination, weather modification, etc.). (Cassar - PTT)
W86-03951

RIVER BASIN DEVELOPMENT: PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON RIVER BASIN DEVELOPMENT.
United Nations Development Programme.
December 4-10, 1981, Dacca, Bangladesh. Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. 239 p.

Descriptors: *Planning, *Water law, *Water resources development, *River basins, *Developing countries, *India, Bangladesh, Ganges River, Brahmaputra River, Water management, Legal aspects, International agreements.

A symposium at Dacca, Bangladesh, presented papers analyzing existing river basin development projects throughout the world and discussing ideas for development in the Indian subcontinent. The great rivers of this region (Ganges and Brahmaputra) travel through several countries. The potential for optimum development of these basins can be realized with international cooperation. Proper river basin development can augment food production and water supplies, improve transport, provide energy, and develop industries. Major problems on these two river systems are damaging floods and water shortages in the dry season. (Cassar - PTT)
W86-03957

SOME MAJOR ISSUES IN RIVER BASIN MANAGEMENT FOR DEVELOPING COUNTRIES,
A. K. Biswas.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 17-27, 2 tab, 14 ref.

Descriptors: *Planning, *Institutions, *Water resources development, *Developing countries, *River basins, Water conservation, Conservation, Employment, Economic aspects, International agreements, Construction, Systems analysis, Water policy, Water management.

River basin development can satisfy the demand for domestic, agricultural, industrial and hydroelectric power generation water uses. This is the reason that such work is becoming increasingly important in all developing countries. Associated with river basin development are four major issues. (1) Efficient use of water must be improved. Agricultural water losses are estimated at 57%. Greatest losses are in the canal system. In many cases less than one-quarter of the water released from a reservoir reaches the fields. Other savings can be realized by increasing recirculation of cooling water. (2) River basin development can generate employment. Labor-intensive techniques can be selected, if desired, in dam construction, tunneling, canal construction and maintenance, and drainage projects. (3) International river basin development involves conflicts among nations. Nine river and lake basins are shared by 6-12 countries; 214 are shared by at least two countries. There are 44 countries where at least 80% of the total area lies within international river basins. (4) To date developing countries have not taken enough advantage of the systems analysis tools available. (Cassar - PTT)
W86-03958

DEVELOPING THE GANGES BASIN,
G. R. Choudhury, and T. A. Khan.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 28-39, 1 fig, 5 ref.

Descriptors: *Planning, *Institutions, *Water resources development, *Developing countries, *River basins, *India, *Nepal, *Bangladesh, Ganges River, International agreements, Water policy, Water management, Irrigation, Water use, Water demand.

The Ganges River basin, shared by India, Nepal, and Bangladesh, is ready for development. A coordinated, wholehearted effort to accomplish this should be initiated. The densely populated (252 million) region drains about 431,200 sq miles. At present irrigation projects are the major form of basin development: in Nepal, 1.5 million acres; in India, 44 million acres; and in Bangladesh, 7.25 million acres. Total estimated surface water requirements from the Ganges and its tributaries by the year 2000 is about 259 MAF. The huge flow of river water that enters the sea unutilized during the flood season offers tremendous potential for storage and conservation to augment the river's dry season flow. In Nepal an additional 50-60 MAF of storage would be available if existing and potential reservoir sites are developed. Storage reservoirs in India could increase the dry-season flow by 88,000 to 130,000 cusec. An international committee of experts from each country is suggested. The first task is an inventory of resources and assessment of needs. (Cassar - PTT)
W86-03959

INTEGRATED DEVELOPMENT OF THE DELTA AND UPLAND PORTIONS OF A RIVER BASIN,
A. Volker.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 40-61, 42 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Deltas, *River basins, Developing countries, Nile River, Mekong River, Rhine River, International agreements, Water policy, Water management, Irrigation, Water use, Water demand, Flood control.

River basin development should not be attempted without considering the relationships between the delta and upland portions. For example, upstream embanking for flood protection produces the following effects downstream and in the delta: higher discharge levels and siltation of the river bed. Lower embankments combined with upstream water storage achieve better results. Upstream flood control reservoirs can produce downstream channel erosion and slow growth or erosion of the deltaic plain. Water stored in tidal lagoons and other coastal depressions tends to evaporate excessively, but it has the advantages of improving protection against storm surges, controlling saline water intrusion, and improving drainage conditions. Three case histories are cited. In the Rhine River delta, salinity derived from upstream sources was a major issue. Extensive documentation and delicate diplomacy was necessary to reach a satisfactory agreement among the involved parties. Egypt and Sudan, whose sole source of water is the Nile River, easily reached agreement on water management of this resource. Some of the adverse conditions existing downstream from the High Aswan Dam are soil salinization and wasting of irrigation water. The Mekong River and delta have been developed with a master plan with an integrated approach. No dikes have been built in the delta area. Inhabitants and crops have adapted to the floods. The major problems are siltation and salt water intrusion in the dry season. Evaluation of alternatives showed that the best plan for continued development is to use the available water to irrigate upstream areas, allowing the delta to remain in a relatively natural condition. (Cassar - PTT)
W86-03960

LOWER MEKONG BASIN DEVELOPMENT,
Chulalongkorn Univ., Bangkok (Thailand).
B. Binson.
IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 69-84, 2 fig, 1 tab, 6 ref, 1 append.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *Mekong River, Economic aspects, International agreements, Water policy, Water management.

In spite of the tremendous pre-investments as well as the existing investments in the Mekong Basin, its mainstream has not yet been crossed or its waters fully utilized, except for pumping over its banks and natural inundations. The tributaries have been made use of widely in Thailand but little has been done in Kampuchea, Lao PDR or Vietnam, mainly due to the political turmoil in those countries. That the Mekong development should have continued at all during these times is a great credit to the committee members. In the past, the Mekong Committee was free of politics and functioned well even when Thailand was at odds with Cambodia over the Phra Viharn Hill controversy. Even when three of the four riparian governments changed from being pro-Western to Socialist, the Committee continued its work. In fact, after the Interim Mekong Committee was set up in 1977, the development work of the Mekong Basin went ahead with renewed vigor. However, aid from cooperating countries is now much harder to get and, as a result, projects are progressing rather slowly. The riparian countries are also short of foreign exchange and, if politics also enter the picture, the Mekong Committee may come on very hard times in the future years. (Author's abstract)
W86-03962

BRAHMAPUTRA RIVER BASIN DEVELOPMENT,
For primary bibliographic entry see Field 6B.
W86-03963

GANGES BASIN DEVELOPMENT: A LONG-TERM PROBLEM AND SOME SHORT-TERM OPTIONS,
M. Zaman.
IN: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 99-109, 3 tab, 6 ref, 1 append.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *India, *Bangladesh, *Ganges River, Economic aspects, International agreements, Water policy, Water management, Irrigation, Flood control, Water storage, Dams, Reservoirs, Storage, Ganges Waters Agreement 1977, Regional planning.

Bangladesh and India hold different views of water resources development programs for the Ganges basin. The Ganges Waters Agreement of 1977, in force for 5 years, provided for sharing of dry season flows with Farakka as the sharing point. Both Bangladesh and India have prepared separate schemes for augmenting dry season flows. The Indian scheme involves transfer of 100,000 cusec of water from the Brahmaputra to the Ganges through a 209-mile canal, a third of which will pass through Bangladesh and join the Ganges at a point above Farakka in India. A barrage would be constructed at Jhogighopa in Assam. The Bangladesh scheme depends on construction of storage dams in the upper reaches of the Ganges basin in Nepal and India. These two views are so different that reconciliation seems difficult. Some short-term options are reduction of percolation losses of irrigation water, careful selection of irrigation project soils, shaping and levelling of irrigation plots, conjunctive use of groundwater and surface water, pond storage of monsoon waters, and changes in cropping patterns. (Cassar - PTT)
W86-03964

REGIONAL CO-OPERATION IN THE UTILIZATION OF WATER RESOURCES OF THE HIMALAYAN RIVER,
Bangladesh Univ. of Engineering and Technology, Dacca. Dept. of Water Resources Engineering.
M. Shahjahan.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 110-123, 13 tab, 11 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *India, *Bangladesh, *Pakistan, *Nepal, Economic aspects, International agreements, Water policy, Water management, Ganges River, Indus River, Brahmaputra River, Meghna River, Irrigation, Flood control, Water storage, Dams, Reservoirs, Storage, Erosion control, Sedimentation, Regional planning.

The Himalayan river system (Indus, Ganges, Brahmaputra, and Meghna) drains a catchment area of 3.2 million sq km in which 500 million persons live. The importance of a regional water resources development strategy is emphasized. The average annual flow is 1,042 million acre feet. Statistics are given for surface water, groundwater, future water availability (1980-2000), and hydropower potential for Pakistan, Nepal, India, and Bangladesh. At present a large proportion of the water from the three main rivers flows to the sea unutilized, particularly in the monsoon season. Regional cooperation is vital for effective utilization of this vast water resource. The destructive floods, especially in downstream India and Bangladesh, could be effectively controlled by constructing storage reservoirs in the tributaries. Bangladesh receives 2-3 billion tons of unwanted sediments from Nepal and India, which lose large quantities of topsoil. This could be reduced by increasing vegetative cover and forest lands in the upstream areas. The best location for hydroelectric power structures is Nepal, a small country with limited capital. Pooling of funds for this purpose is desirable. Shared technology, such as data exchange and environmental monitoring, is another opportunity for regional cooperation. (Cassar-PTT)

W86-03965

FUNCTIONS OF INTEGRATED NATIONAL WATER PLANNING IN THE NETHERLANDS AND BANGLADESH,
K. P. Blumenthal.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 124-136, 2 fig, 10 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *Bangladesh, *The Netherlands, Water policy, Water management, Polders, Dikes, Drainage, Flood control.

Granting the many differences, the Netherlands and Bangladesh have many technical aspects of water management problems in common. A description of the historic water developments of a country like The Netherlands contains some useful hints concerning local aspects of development policy. Development begins in small communities. It is therefore instrumental for development policy to give farmers and agricultural communities the incentive of serving their own interests by making the necessary effort. A national integrated water management plant in a developed country has a different function for such a plan in a developing country: in the latter case, it is a frame of reference to judge the usefulness and priorities of projects. Because of its multidisciplinary nature, policy analysis can hardly be done in most countries, developed or otherwise, without external help: it should, however, include the training necessary to continue with the country's own resources. The discussion leaves the question open as to whether or not a policy analysis effort might be a useful object for development aid. The experience that developments desired by everyone take far more time than anyone expects is not limited to developing countries. Disappointments may, however, be used in a constructive way. (Author's abstract)
W86-03966

MANAGEMENT OF RIVER SYSTEMS IN THE GANGES AND BRAHMAPUTRA BASINS FOR DEVELOPMENT OF WATER RESOURCES,
M. F. A. Siddiqui.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 137-149, 4 ref.

Descriptors: *Planning, *Political constraints, *Water resources development, *Developing countries, *River basins, *Bangladesh, *India, Water policy, Water management, International agreements, Ganges River, Brahmaputra River, Meghna River, Flood control, Saline intrusion, Navigation, Water storage, Storage, Reservoirs.

Water and politics are closely interconnected. Invariably, the final decision to develop international water resources projects is part of the political process. Engineers do not make final decisions nor do they pass legislation that affects the planning process. They do evaluate the cost effectiveness of alternative proposal which helps the politicians' decisionmaking. In fact, water resources planning, project authorization and financing are all essentially political processes. Conflict and distrust among the nations of the Indian subcontinent complicates the exchange of data and the negotiation process. Thus far, these countries are determined to get their fair share of water resources rather than work together. India has been discussing separate plans for Ganges River development with Nepal and Bangladesh, rather than one agreement among all the involved parties. Unless the outlook changes, the possibility of establishing pooled resources are very remote. (Cassar - PTT)
W86-03967

INTERNATIONAL RIVER LAW,
D. A. Caponera.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 173-184.

Descriptors: *Planning, *Water law, *Political constraints, *Water resources development, *River basins, *International law, Developing countries, Water policy, Water management, Legal aspects, Water rights.

International water law gives a state the right to develop unilaterally that section of the watercourse which traverses or borders its territory, insofar if the development is not likely to cause substantial and lasting injury in the territory of another state or inconvenience incompatible with good neighborly relations. If an injury is likely to be substantial and lasting, the development may be undertaken only subject to prior agreement. Although a state is not required to obtain the prior consent of other basins states for a water development project, there is a legal duty to give notice wherever another state's rights are seriously affected. Close cooperation between all basin states should be firmly established. This involves exchange of technical data, exchange of plans and proposals, coordination of plans among co-basin states, and joint management for the operation of major hydraulic structures. The ideal is joint planning for development of the whole basin. Cooperation must be established on good faith, good neighborliness, equality and reciprocity. All basin states should consider not only their own interests but those of the basin community as a whole. (Cassar - PTT)
W86-03970

INSTITUTIONAL AND LEGAL FRAMEWORK FOR CO-OPERATION BETWEEN BANGLADESH AND INDIA ON SHARED WATER RESOURCES,
M. Zaman.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 185-194, 4 ref.

Descriptors: *Planning, *Water law, *Water resources development, *River basins, *Bangladesh, *India, Treaties, Developing countries, Water policy, Water management, International law, Legal aspects, Water rights, Political constraints, Ganges River, Institutional constraints, International agreements, Ganges Waters Agreement of 1977, Equitable apportionment.

Treaties are a common mechanism for sharing water resources in international river basins. India and Bangladesh have entered into two treaties for harnessing the water resources of the rivers common to them. The Agreement of 1972, which created the Joint River Commission, is a forum for maintaining liason between the two countries regarding maximum benefits, flood control works, irrigation projects, and research on advanced warning for floods and cyclones. The Ganges Waters Agreement of 1977, more elaborate and specific, requires the two states to devise means to augment dry season flows, allocates dry season flows, provides a joint committee to supervise the sharing, provides for review of the Agreement, and requires that disputes be referred to the two governments for settlement. (Cassar - PTT)
W86-03971

LAW OF INTERNATIONAL WATER RESOURCES SYSTEMS,
City Univ. of New York.
R. D. Hayton.
In: River Basin Development: Proceedings of the National Symposium on River Basin Development, December 4-10, 1981, Dacca, Bangladesh. 1983. p 195-239, 13 ref, 6 annexes.

Descriptors: *Planning, *Water law, *International law, *Water resources development, *Rivers, Water policy, Water management, Legal aspects, Water rights, International agreements, Institute of International Law, International Law Association, United Nations, Equitable appropriation, Helsinki Rules, International Law Commission.

International river law is summarized. History is discussed with attention to navigation laws, non-navigation laws, and the awareness of water's harmful effects. Work of two groups is described. The Institute of International Law is a private professional organization concerned with river law. The International Law Association, a professional organization devoted to international law, has produced the well-used Helsinki Rules, based on the equitable utilization principle. Many supplements to the Rules have been formulated to address specific topics such as flood control and marine pollution. Several intergovernmental organizations, including United Nations organs and conferences, are also active. The International Law Commission has published a number of special reports. Currently, international law is based on the principle of equitable utilization, which is now universally accepted. However, application of this principle is not always easy. The concept of shared natural resources is also firmly entrenched. Navigation laws are quite clear, with some loss of individual freedom compared with the last century. Recently, the duty to consult has become well established. Several annexes to the paper present excerpts from the International Law Commission's 32 session (May-July 1980), the Helsinki Rules, post-1966 articles of the International Law Association, the Institute of International Laws' statements on use of international non-maritime waters except for navigation and river and lake pollution, and draft propositions on international river law by the Asian-African Legal Consultative Committee. (Cassar - PTT)
W86-03972

GROUND WATER QUALITY PROTECTION: THE ISSUE IN PERSPECTIVE,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5G.
W86-04043

SATURATED THICKNESS FOR DROUGHT AND LITIGATION PROTECTION,
Arkansas Univ., Fayetteville. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 4B.
W86-04280

COOPERATIVE SERVICE ARRANGEMENTS,
Department of Commerce, Washington, DC.
For primary bibliographic entry see Field 5G.
W86-04283

CURRENT STATUS IN USE OF FLEXIBLE EFFLUENT STANDARDS,
North Carolina Univ. at Chapel Hill. Dept. of Environmental Sciences and Engineering.
For primary bibliographic entry see Field 5G.
W86-04329

GROUNDWATER CONTAMINATION: A NATIONAL PROBLEM WITH IMPLICATIONS FOR STATE AND LOCAL ENVIRONMENTAL HEALTH PERSONNEL,
Winnebago County Dept. of Public Health, Rockford, IL.
For primary bibliographic entry see Field 5B.
W86-04609

6F. Nonstructural Alternatives

GUIDELINES ON COMMUNITY LOCAL FLOOD WARNING AND RESPONSE SYSTEMS.
Interagency Advisory Committee on Water Data, Reston, VA. Hydrology Subcommittee.
August 1985. 104 p, 12 fig, 2 tab, 34 ref, 2 append.

Descriptors: *Flood protection, *Flood basins, *Flood control, Flood channels, Floodproofing, Flood damage, Flood data, Flooding, Public relations, Benefits, Public participation.

The heavy loss of life and property resulting from the occupation of flood-prone lands adjacent to water sources has resulted in the need for flood

warning and response systems. A variety of aspects of such systems are discussed. The specific topics include: local flood warning systems, community response systems, an integrated local flood warning and response system, the role of government agencies, dam safety activities, the Unified National Program for Flood Plain Management, and the Association of State Flood Plain Managers. (Halterman - PTT)
W86-03913

6G. Ecologic Impact Of Water Development

CLASS III CULTURAL RESOURCE INVENTORY, PARADOX VALLEY UNIT, COLORADO RIVER BASIN SALINITY CONTROL PROJECT, MONTROSE COUNTY, COLORADO,
Complete Archaeological Service Associates, Cortez, CO.
N. S. Hammack.
Report No. 4, November 25, 1985. 37 p, 20 fig, 10 ref, 1 append. Contract No. 4-CS-40-01650.

Descriptors: *Archaeology, *Water resources development, *Resources development, *Saline water, *Colorado, Salinity, Colorado River Basin, Water conveyance, Dolores River.

A Class III cultural resource inventory of 360 acres and four miles of 450 foot wide linear right-of-way was carried out by Complete Archaeological Service Associates (CASA) in the Paradox Basin of west central Colorado for the Bureau of Reclamation. This project is part of the Paradox Valley Unit of the Colorado River Basin Salinity Control Project. During this inventory eight new sites were recorded and one isolated flaked lithic artifact was located. One previously recorded site was reevaluated. The eight newly recorded sites include four historic sites and four prehistoric lithic scatters. None of the historic sites are considered to be eligible for nomination to the National Register of Historic Places and only three of the prehistoric sites contained sufficient research potential for inclusion in the NRHP. (Author's abstract)
W86-03911

CLASS II CULTURAL RESOURCE SURVEY UPPER GILA WATER SUPPLY STUDY CENTRAL ARIZONA PROJECT, VOLUME 1,
Deuel and Associates, Inc., Albuquerque, NM.
R. C. Chapman, C. W. Gossett, and W. J. Gossett.
October 1985. 212 p, 13 ill, 28 tab, 9 ref. Contract No. 3-CS-30-00150.

Descriptors: *Archaeology, *Water resources development, *Resources development, Water use, Water delivery, Water demand, Central Arizona Project, Water conveyance, Resources allocation.

The results of a Class II cultural resource survey, carried out as part of the Bureau of Reclamation Upper Gila Water Supply Study for the Central Arizona Project, are presented in a two-volume report. Volume I includes discussions of four projects along the Upper Gila River in the vicinity of Cliff, New Mexico and three projects along the lower San Francisco River northeast of Clifton, Arizona. Central features of the field effort included an experimental attempt to use digitized LANDSAT data interactively during the course of the survey, a sample design area emphasizing vegetative and topographical strata, and field studies of vegetation, mineral resources, and geomorphology. Significant new research concerning ceramics and lithic artifacts are summarized. (Halterman - PTT)
W86-03915

CLASS II CULTURAL RESOURCE SURVEY UPPER GILA WATER SUPPLY STUDY CENTRAL ARIZONA PROJECT, VOLUME 2,
Deuel and Associates, Inc., Albuquerque, NM.
R. C. Chapman, C. W. Gossett, and W. J. Gossett.
October 1985. 210 p, 24 ill, 42 tab. Contract No. 3-CS-35-00150.

Descriptors: *Archaeology, *Water resources, *Resources development, *Water conveyance, Water use, Water delivery, Water demand, Central Arizona Project, Development, Resources allocation.

The results of a Class II cultural resource survey, carried out as part of the Bureau of Reclamation Upper Gila Water Supply Study for the Central Arizona Project, are presented in a two-volume report. Volume II presents discussions of lithic artifacts assemblages and their implications for geographical space and organizational systems, architecture and use of site space, patterns in prehistoric space use and organizational systems in the upper San Francisco and Gila Rivers, a historic settlement along the upper Gila and low San Francisco Rivers, and summary and conclusions of the the entire study. (Halterman - PTT)
W86-03916

LONG-DISTANCE WATER TRANSFER: A CHINESE CASE STUDY AND INTERNATIONAL EXPERIENCES.
United Nations Univ., Tokyo (Japan).
For primary bibliographic entry see Field 6D.
W86-03918

LONG-DISTANCE WATER TRANSFER: PROBLEMS AND PROSPECTS,
Biswas and Associates, Oxford (England).
For primary bibliographic entry see Field 6D.
W86-03919

RIVER NILE: MAIN WATER TRANSFER PROJECTS IN EGYPT AND IMPACTS ON EGYPTIAN AGRICULTURE,
Water Research Centre, Cairo (Egypt).
For primary bibliographic entry see Field 6D.
W86-03920

AGRICULTURAL WATER MANAGEMENT AND THE ENVIRONMENT,
Colorado State Univ., Fort Collins. Dept. of Agricultural and Chemical Engineering.
For primary bibliographic entry see Field 6D.
W86-03921

JAPANESE WATER TRANSFER: A REVIEW,
Iwate Univ., Morioka (Japan). Faculty of Agriculture.
For primary bibliographic entry see Field 6D.
W86-03922

TEXAS WATER SYSTEM: IMPLICATIONS FOR ENVIRONMENTAL ASSESSMENT IN PLANNING FOR INTERBASIN WATER TRANSFERS,
Indiana Univ. at Bloomington. Dept. of Geography.
For primary bibliographic entry see Field 6D.
W86-03923

CHINA'S SOUTH-TO-NORTH WATER TRANSFER PROPOSALS,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6D.
W86-03924

LAND USE AND CROP ALLOCATION IN THE PROPOSED WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6D.
W86-03926

ENVIRONMENTAL IMPLICATIONS OF WATER TRANSFER,
Bayreuth Univ. (Germany, F.R.). Lehrstuhl fuer Hydrologie.
For primary bibliographic entry see Field 6D.
W86-03928

IMPACT OF WATER TRANSFER ON THE NATURAL ENVIRONMENT,
Academia Sinica, Beijing (China). Inst. of Geography.
X. Yuexian, and H. Jialian.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 159-167, 1 ref.

Descriptors: *Water transfer, *Water use, *Environmental effects, *China, *Diversion, Water supply, Canals, Water supply development.

The impacts of the projected south-north water transfer project in China include several related to the natural environment. Major areas of concern are impacts on water resources in the Chang Jiang Basin, impacts on the navigation channel of the Chang Jiang, impacts on seawater intrusion in the Chang Jiang estuary, impacts on aquatic life, such as algae, aquatic weeds, plankton, benthos and fish, impacts on the quality of transported water, impacts on the migration patterns of schistosomiasis, impacts on climate, and the salinization of irrigated lands. (Halterman - PTT)
W86-03929

IMPACT OF SOUTH-TO-NORTH TRANSFER UPON THE NATURAL ENVIRONMENT,
Academia Sinica, Beijing (China). Inst. of Geography.
L. Changming, and Z. Dakang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 169-179, 2 ref.

Descriptors: *Water transfer, *Water use, *Environmental effects, *China, Diversion, Canals, Water supply, Water supply development, Natural resources.

Several potential impacts of the south-north water transfer project in China are discussed. Impacts on the natural environment are emphasized for the water exporting region, the transfer region, and the water importing region. Protection of water resources by controlling the amount of water diverted, enacting laws to protect water quality during transfer, and lining canals to minimize seepage loss, are outlined. Similarly, steps to assure the protection of soil resources as well as aquatic and mineral resources are discussed. (Halterman - PTT)
W86-03930

CHANG JIANG DIVERSION PROJECT: AN OVERVIEW OF ECONOMIC AND ENVIRONMENTAL ISSUES,
International Food Policy Research Inst., Washington, DC.
For primary bibliographic entry see Field 6D.
W86-03932

WATER BALANCE IN THE WATER TRANSFER REGION,
Academia Sinica, Beijing (China). Inst. of Geography.
For primary bibliographic entry see Field 6D.
W86-03933

PROBLEM OF WATER SUPPLY IN THE HAILUAN PLAIN,
Academia Sinica, Beijing (China).
For primary bibliographic entry see Field 6D.
W86-03940

EFFECT OF SOUTH-TO-NORTH WATER TRANSFER ON SALTWATER INSTRUSION IN THE CHANG JIANG ESTUARY,
S. Huanting, M. Zhichang, G. Guochuan, and X. Pengling.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 351-359, 1 fig, 1 tab.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *China, Canals, Irrigation, Economic aspects, Environmental effects, Water storage, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the patterns of saltwater intrusion into the Chang Jiang are explored, and possible impacts are estimated. If water is transferred at the rate of 1,000 cu m per second, saltwater intrusion will definitely be worsened in the Chang Jiang estuary, primarily in the dry season. This will alter the environment of fishery resources. The interbasin transfer of water closely affects both the importing and exporting basins. Water sources in north China must be considered, so the water needs from outside can be estimated. The south-north water transfer must be joined with the drawing up of comprehensive long-term plans for the Huang He and Chang Jiang basins. (Halterman - PTT)
W86-03943

POSSIBLE EFFECTS OF THE PROPOSED EASTERN TRANSFER ROUTE ON THE FISH STOCK OF THE PRINCIPAL WATER BODIES ALONG THE COURSE,
Wuhan Inst. of Hydrobiology (China).
Y. Xuefang.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 373-388, 1 fig, 6 tab, 3 ref, 1 append.

Descriptors: *Water transfer, *Environmental effects, *Fish, *Fisheries, *Water supply development, *China, Diversion, Irrigation.

As part of the assessment of the proposed east route of the south-north water transfer in eastern China, the influence on fish stock of the water bodies along the route were studied. The general condition of the principal water bodies along the route is discussed. The relation between the runoff in the Chang Jiang and the fish stock in the lower reaches and the estuary are outlined. The fish in the estuary and offshore waters are described, with emphasis on migratory fish. The effects of pumping stations on the fish are discussed, and the changes in the biocommunity of the transit lakes after the transfer of water are projected. In general, the project is expected to have an adverse effect on several aspects of the fisheries involved. (Halterman - PTT)
W86-03945

EFFECT OF DIVERTING WATER FROM SOUTH TO NORTH ON THE ECOSYSTEM OF THE HUANG-HUAI-HAI PLAIN,
Academia Sinica, Nanjing (China). Nanjing Inst. of Soil Science.
Z. Shouquanm, W, Zunqin, and H. Yi.
In: Long-Distance Water Transfer: A Chinese Case Study and International Experiences, Tycooly International Publishing Ltd.: Dublin, Ireland, 1983. p 389-394, 5 ref.

Descriptors: *Water transfer, *Water supply, *Water supply development, *Diversion, *Environmental effects, *China, Irrigation, Water conveyance.

As part of the overall assessment of the proposed south-north water transfer in eastern China, the potential impacts on the environment of the Huang-Huai-Hai plain are discussed. Following a presentation of background information, on the characteristics of plains, several potential effects are outlined. Examples of impacts are: altered water-salt balance, interference with existing drainage systems, altered flood control and drainage systems, and altered cropping structure. Several recommendations for improving the ecology of the plain increasing the effectiveness of the project, are outlined, including thorough scientific study prior to construction, and sound and scientific management of the program once it is built. (Halterman - PTT)
W86-03946

LARGE SCALE WATER TRANSFERS: EMERGING ENVIRONMENTAL AND SOCIAL EXPERIENCES.
United Nations Environment Programme, Nairobi (Kenya).
For primary bibliographic entry see Field 6E.
W86-03948

PARTIAL SOUTHWARD DIVERSION OF NORTHERN AND SIBERIAN RIVERS,
G. V. Vorapaev, and A. L. Velikanov.
IN: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 67-83, 4 fig.

Descriptors: *Planning, *Environmental effects, Water transfer, Interbasin transfer, Diversion, Rivers, Reservoirs, Social aspects, Russia, Economic aspects, Water supply development, Irrigation, Water conservation, Volga River, Climatology, Caspian Sea, Azov Sea, Fish, Salinity, Siberia, Water level, Water management.

The uneven distribution of the Soviet Union's vast water resources (84% concentrated in Siberia) led to two water transfer projects initiated about 20 years ago: (1) partial redistribution of water from northern European part of the country to the Caspian Sea basin and (2) partial diversion of Siberian rivers to the Urals and several sections in Asiatic part of the country. Details of the research on these diversions are used to illustrate the planning used for diversion projects. For the Volga River diversion from northern rivers, engineering study results recommended an annual diversion of 19-20 cu km by the year 2000, in three stages. Among the probable decreased streamflow, increased water temperature, drainage of swampy areas, increase in eutrophication, better flood control, disruption of fish migration and navigation. Fish production would be enhanced in some locations and adversely affected in others. In the Caspian Sea region receiving the water transfer would help to stabilize the dropping Caspian Sea levels. The Siberian rivers diversion involves 25-27 cu km of water annually. The region of the water source would show lower summer water temperatures, poorer water quality in winter, little alteration in sea water quality or climate, drainage of some existing swamps and formation of swamps in other areas, loss of fodder, and reduction in fish spawning area and in fish production. Social and economic aspects of both diversions are considered. (Cassar - PTT)
W86-03952

JONGLEI CANAL: A CONSERVATION PROJECT OF THE NILE,
Associated Consultants, Khartoum (Sudan).
Y. A. Mageed.
In: Large Scale Water Transfers: Emerging Environmental and Social Experiences, Tycooly Publishing Ltd: Oxford, England, 1985. p 85-101, 6 fig, 5 ref.

Descriptors: *Planning, *Environmental effects, Water transfer, Interbasin transfer, Diversion, Rivers, Canals, Social aspects, Economic aspects, Water supply development, Livestock, Jonglei Canal, Sudan, Fish, Swamps, Drainage, Wildlife, Migration, Nile River, Water management.

The Jonglei Canal, Sudan, is designed to reduce Nile River water losses by diverting 20 million cu m/day of water from the river at Bor through a 360 km canal to the mouth of the River Sobat, bypassing the swamps, where evaporation losses are considerable. The environmental, economic, and social impacts of the canal were studied. It is believed that no climatic changes will be perceived. The natural variation in the swamp area is greater than the changes induced by the canal. In unusually dry years, the water withdrawals can be regulated so that swamps with their associated wildlife and beneficial uses are preserved. The traditional movements of tribes and their livestock have been considered in planning the alignment of the canal to minimize disruption of traditional land use patterns. Ferries and bridges will also be provided to facilitate crossing. Canal modification facilitates swimming by livestock and wildlife. Livestock grazing will be enhanced by both the permanent water source provided by the canal and the addition of drained swamp to the pasture area. However, migration and movement of some wildlife, notably the migratory tiang, will be curtailed. Important economic benefits include improved travel by canal and bank road, a permanent water supply, and the year-round availability of fish. (Cassar - PTT)
W86-03953

RIVER BASIN DEVELOPMENT: PROCEEDINGS OF THE NATIONAL SYMPOSIUM ON RIVER BASIN DEVELOPMENT.
United Nations Development Programme.
For primary bibliographic entry see Field 6E.
W86-03957

INTEGRATED DEVELOPMENT OF THE DELTA AND UPLAND PORTIONS OF A RIVER BASIN,
For primary bibliographic entry see Field 6E.
W86-03960

MODEL OF THE AQUIFERS IN THE LLOBREGAT DELTA (CATALONIA, SPAIN),
Curso International de Hidrolgia Subterranea, Barcelona (Spain).
For primary bibliographic entry see Field 2F.
W86-03976

MODELING OF THE SUBSIDENCE OF VENICE,
Centro di Ricerca IBM di Venezia (Italy).
G. Gambolati, P. Gatto, and R. A. Freeze.
IN: Ground-water Models, Volume I: Concepts, Problems, and Methods of Analysis with Examples of their Application, The UNESCO Press: Paris, France, 1982. p 143-150, 6 fig, 2 tab, 4 ref.

Descriptors: *Environmental effects, *Groundwater, *Subsidence, *Model studies, Venice, Italy.

A model was used to study the effects of several groundwater pumping schemes on the subsidence of Venice, Italy, which lies at an elevation of 0.5 to 1.5 m above sea level. Since the pumping rate has been reduced by 60% as of the end of 1976, subsidence has probably been arrested. Total subsidence increased from zero in 1930 to a high of 12.5 cm in 1970, then leveled off at 11 cm, where it is predicted to remain until 2000. (Cassar - PTT)
W86-03987

MODELING OF GROUND-WATER HYDROLOGY IN THE HOUSTON DISTRICT, TEXAS,
Kansas State Geological Survey, Lawrence.
For primary bibliographic entry see Field 2F.
W86-03989

MULTIPLE COMPLETION MONITOR WELLS,
McLaren Environmental Engineering, Inc., Rancho Cordova, CA.
For primary bibliographic entry see Field 4B.
W86-04207

ASSESSING POPULATION EFFECTS FROM ENTRAINMENT OF FISH AT A LARGE VOLUME WATER INTAKE,
Battelle Pacific Northwest Labs., Richland, WA.
For primary bibliographic entry see Field 8I.
W86-04383

CHANNEL FORM AND STREAM ECOSYSTEM MODELS,
Arkansas Univ., Fayetteville. Dept. of Zoology.
P. P. Brussock, A. V. Brown, and J. C. Dixon.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 859-866, October 1985. 2 fig, 48 ref. NSF ISP 8011447.

Descriptors: *Aquatic habitats, *Bottom sediments, *Channel morphology, Sand, Lithology, Runoff,

Geomorphology, Lotic environment, Stream Classification, Ecosystems.

A system is proposed to classify running water habitats based on their channel form, which can be considered from three different sedimentological settings: a cobble and boulder bed channel, a gravel bed channel, or a sand bed channel. Three physical factors (relief, lithology, and runoff) were selected as state factors that control all other interacting parameters associated with channel form. When these factors are integrated across the conterminous United States, seven distinct stream regions are evident, each representing a most probable succession of channel forms downstream from the headwaters to the mouth. Coupling these different channel profiles with typical biotic community structures associated with each of the channel types should result in considerable refinement of the applicability of the River Continuum Concept and other holistic ecosystem models by realizing the nonradomness of the effects of geomorphology on stream ecosystems. This regional perspective of streams should serve to make persons concerned with water resources more aware of the geographical considerations that affect their study areas. (Rochester-PTT)
W86-04537

EVALUATING A CUMULATIVE IMPACT ASSESSMENT APPROACH,
Iowa Univ., Iowa City. Inst. of Urban and Regional Research.
C. K. Contant, and L. Ortolano.
Water Resources Research WRERAO, Vol. 21, No. 9, p 1313-1318, September 1985. 2 tab, 18 ref.

Descriptors: *Impact assessment, *Cumulative impacts, *Project planning, Corps of Engineers, San Francisco, Monitoring, Statistical analysis, permits.

A new procedure was formulated to predict and monitor the cumulative impacts of projects requiring Corps of Engineers permits. To evaluate the effectiveness of this new assessment approach, hypotheses describing relationships between an independent variable, use of the cumulative impact approach, and nine dependent variables were developed. A quasi-experiment, in which the cumulative impact assessment approach was the treatment, was conducted to determine how the approach influenced the permit review process. The evaluation procedure was applied to the test implementation of the cumulative impact assessment approach at the San Francisco District. The primary weakness of this application of the quasi-experimental evaluation procedure was that statistical arguments about the effectiveness of the new assessment approach could not be made due to limited data. Another limitation was that application of the quasi-experimental design in only one study area does not allow direct generalization to other locations. The principal strength of this research is the quasi-experimental design, which provides a clear, systematic structure for collecting and evaluating information on the effectiveness of any cumulative impact assessment technique. (Rochester-PTT)
W86-04539

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. I. IMPLEMENTATION AND EFFECTIVENESS,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. S. Richey, B. W. Mar, and R. R. Horner.
Journal of Environmental Management JEVMA, Vol. 21, No. 2, p 135-146, September 1985. 2 fig, 9 ref. EPRI Project RP-1729-1.

Descriptors: *Project planning, *Delphi technique, *Monitoring, *Decision making, *Questionnaires, *Management planning, Evaluation, Design criteria, Water resources development, Future planning, Ecological effects, Environmental effects.

The effectiveness with which a panel of experts, operating within the context of a Delphi technique, could be used to develop data for use in environmental monitoring program design and environmental decision-making was studied. The Delphi technique was evaluated to determine selection criteria for an expert panel, how many panelists are needed, what types of data can be considered effectively, and how many iterations are necessary. The selection criteria used to choose a panel of professionals involved in the field of electrical utility monitoring to participate in the Delphi technique are outlined. Small panels consisting of <10 individuals representing a variety of areas of experience appeared sufficient for developing information about conceptual or philosophical issues. Neither large nor small panels were effective for considering factual or data-based issues. Two iterations (initial questionnaire with one follow-up) were adequate to determine the panel consensus. The costs of implementing the Delphi technique were 10 to 60% of those of retaining a panel of experts or the nominal group technique. (Geiger-PTT)
W86-04596

DELPHI TECHNIQUE IN ENVIRONMENTAL ASSESSMENT. II. CONSENSUS ON CRITICAL ISSUES IN ENVIRONMENTAL MONITORING PROGRAM DESIGN,
Washington Univ., Seattle. Dept. of Civil Engineering.
J. S. Richey, R. R. Horner, and B. W. Mar.
Journal of Environmental Management JEVMA, Vol. 21, No. 2, p 147-159, September 1985. 1 tab, 14 ref. EPRI Project RP-1729-1.

Descriptors: *Project planning, *Monitoring, *Delphi technique, *Environmental effects, *Electric powerplants, Evaluation, Decision making, Questionnaires, Design criteria, Water resources development, Future planning, Ecological effects, Management planning.

In many complex environmental assessment tasks, the utilization of expert opinion is necessary when quantitative information is inadequate and when the cost of obtaining new knowledge is too expensive or too time consuming. The consensus of a panel of experts on a number of critical issues relating to the design of environmental monitoring programs is presented. Included in the set of issues studied are the general structure and content of environmental monitoring program, the major causes and effects of changes brought about by thermal electric powerplants on aquatic environments, the protocol for defining hypotheses to test, and estimates of natural variability and sampling errors associated with tests of specific hypotheses in an aquatic environment. Consensus opinions for these issues developed from a Delphi process used with a panel of 62 experts provide a point of departure for future design of environmental monitoring programs. As a result of the scoring system used in the Delphi questionnaire, importance rankings for the various criteria of the monitoring program were also identified. (Geiger-PTT)
W86-04597

7. RESOURCES DATA

7A. Network Design

METHODS OF HYDROLOGICAL COMPUTATIONS FOR WATER PROJECTS.
United Nations Educational, Scientific and Cultural Organization, Paris (France). International Hydrological Programme.
UNESCO: Paris, France, 1982. Edited by B. S. Eichert, J. Kindler, G. A. Schultz and A. A. Sokolov. 122 p, 6 tab, 331 ref.

Descriptors: *Data collections, *Hydrology, *Model studies, *Planning, *Water resources development, Surface water, Hydrologic models, Meteorologic data collections, Hydrologic data collections, Sediment, Statistical analysis, Mathematics, Regional planning, Flow, Reservoirs, Flood control, Hydroelectric power, Multipurpose reservoirs, Water storage, Storage, Data interpretation, Frequency analysis, Design floods, Wind, Wave action, Environmental effects, Computer programs.

This guidebook for surface water hydrologic computations is directed to engineers and hydrologists planning water resources projects. Details of the computations are not included; the user is referred to information in other publications. The basic steps in water resources development are planning, design, construction, and operations. An overview of hydrological computations presents background information on hydrologic and meteorological data and its processing. Hydrological techniques are introduced. These include regional analysis for generation of missing data, reestablishment of natural flows, analysis of flow variability, and hydrologic modeling. Methods are given for estimating: (1) reservoir projects (general and reservoirs with flood control storage, hydroelectric power storage, conservation storage, multipurpose use, mixes of reservoirs), (2) nonreservoir projects (flood control, water quality control, irrigation, drainage, water supply, navigation, and recreation), and (3) basin-wide long-term planning of integrated water resource development. The many techniques available for water projects are classified into several broad categories: regional analysis of data, natural flows, annual flow variability and intra-annual flow distribution, extreme-discharge and stage frequency curves, design floods, freeboard requirements for wind and wave action, water surface profiles, reservoir storage requirements, reservoir operation, and the effects of projects on flow, evaporation, sediment movement, groundwater, and environmental quality. (Cassar - PTT)
W86-04000

SOME CONCEPTS PERTAINING TO INVESTIGATIVE METHODOLOGY FOR SUBSURFACE PROCESS RESEARCH,
Robert S. Kerr Environmental Research Lab., Ada, OK.
For primary bibliographic entry see Field 5B.
W86-04086

MONITORING STATISTICS,
National Research Council, Washington, DC.
For primary bibliographic entry see Field 5A.
W86-04137

CHEMICAL CONTAMINATION OF WATER SUPPLIES,
North Carolina Univ. at Chapel Hill. School of Public Health.
For primary bibliographic entry see Field 5C.
W86-04147

MEASUREMENT, SCALE, AND SCALING,
Purdue Univ., Lafayette, IN. Water Resources Research Center.
J. H. Cushman.
Water Resources Research WRERAO, Vol. 22, No. 2, p 129-134, February 1986. 1 fig, 21 ref.

Descriptors: *Measuring instruments, *Theoretical analysis, *Theoretical values, Heterogeneity, Laboratory equipment, Variability, Measured values, Computed values.

The relationships between measurement, scale, and scaling are discussed and analyzed in detail. It is pointed out that only certain fundamental properties can be measured and that these properties do not include constitutive variables. the interrelationships between scale and measurement are shown to manifest themselves in two types of heterogeneity which we label as explicit and implicit. An important issue that is addressed for the first time is the necessity of scaling instruments when scaling laboratory experiments up to field scale or vice versa. Explicit constraints that scaled instruments must satisfy are derived for the frequency response of the instrument. It is shown that linear interpolators can be reviewed as filters (instruments), but that these interpolators don't preserve the scale constraints of the instrument used in making the field measurements. The relationship between signal conditioning and the instrument's window is isolated and shown to be a multiple convolution over the spatial coordinates (corresponding to the

window) followed by a temporal convolution for the signal conditioning. (Author's abstract)
W86-04167

OPTIMIZATION OF A SNOW NETWORK BY MULTIVARIATE STATISTICAL ANALYSIS,
Centro di Ricerca Idraulica e Strutturale, Milan (Italy).
For primary bibliographic entry see Field 2C.
W86-04395

SOME CONSIDERATIONS OF ENHANCED WATER QUALITY MONITORING IN THE NORTHWEST TERRITORIES: AN INLAND WATERS DIRECTORATE PERSPECTIVE,
Inland Waters Directorate, Yellowknife (Northwest Territories).
For primary bibliographic entry see Field 5G.
W86-04489

GROUNDWATER MONITORING WITHIN AN AQUIFER - A PROTOCOL,
Albuquerque Environmental Health and Energy Dept., NM.
For primary bibliographic entry see Field 5G.
W86-04611

SHALLOW SEISMIC REFRACTION SURVEY OF NEAR-SURFACE GROUND WATER FLOW,
Wisconsin Univ.-Milwaukee. Dept. of Geological Sciences.
For primary bibliographic entry see Field 2F.
W86-04658

7B. Data Acquisition

GROUNDWATER POLLUTION IN NORTHWEST ARKANSAS,
Arkansas Univ., Fayetteville. Dept. of Civil Engineering.
For primary bibliographic entry see Field 5B.
W86-04074

DIELECTRIC PROPERTIES OF SATURATED SOILS,
Oklahoma State Univ., Stillwater. Dept. of Physics.
For primary bibliographic entry see Field 2G.
W86-04087

ADAPTATION OF THE CARTER-TRACY WATER INFLUX CALCULATION TO GROUNDWATER FLOW SIMULATION,
Geological Survey, Denver, CO.
For primary bibliographic entry see Field 2F.
W86-04206

TRANSIOMETER: AN ALTERNATIVE METHOD OF SOIL MOISTURE MEASUREMENT IN SLOWLY PERMEABLE SOILS,
Science and Education Administration, Fort Collins, CO. Agricultural Research.
For primary bibliographic entry see Field 2G.
W86-04216

ELECTRONIC SENSING DEVICES USED FOR IN SITU GROUND WATER MONITORING,
Woodward-Clyde Consultants, Overland Park, KS.
J. D. Ritchey.
Ground Water Monitoring Review, Vol. 6, No. 2, p 108-113, Spring 1986. 3 fig, 3 tab, 24 ref.

Descriptors: *Electronic equipment, *Sensors, *Groundwater monitoring, Computers, Water quality, Monitoring, Temperature, Measuring instruments, Hydrogen ion concentration, Conductance, Dissolved oxygen, Data acquisition, Data storage.

Progress in the field of electronics and computers has produced data acquisition equipment beneficial to groundwater field studies. This equipment controls data collection from sensing devices and saves the data for later processing. There are many types of sensors available for in situ use in water quality monitoring wells, observations wells, and water supply wells. Sensors are separated into two groups, those used to measure water levels and those used to measure water quality parameters. There are three major types of sensors for measuring water levels. They are floats, transducers and acoustic devices. Most types have proven accuracy and can be successfully applied to short-term monitoring and long-term field studies. They are most cost-effective when augmented with the programmability of computers. Sensors to measure water quality include those that measure temperature, pH, specific conductance, dissolved oxygen and specific ions. A potential use of water quality sensors for in situ investigations is to aid in surveillance monitoring to indicate the arrival of contaminants at the earliest possible moment. This has a narrow limit of practicality at this time because of problems associated with sensor accuracy. (Lantz-PTT)
W86-04217

FM RADIOTELEMETRY COUPLED WITH SONIC TRANSDUCERS FOR REMOTE MONITORING OF WATER LEVELS IN DEEP AQUIFERS,
Corps of Engineers, Winchester, VA. Middle East Div.
J. W. Alderman.
Ground Water Monitoring Review, Vol. 6, No. 2, p 114- 116, Spring 1986.

Descriptors: *Radiotelemetry, *Sonic transducers, *Remote sensing, *Aquifers, Water levels, Monitoring, Observation wells, Temperature effects.

Instrumentation specialists at Waterways Experiment Station, Vicksburg, Mississippi, were tasked with providing a complete system for monitoring the piezometric surface in five observation wells. The design criteria, which was provided, was complex and included several major factors. These included: (1) The well owners were not technically oriented and needed a simple system requiring little effort in physically collecting or reducing the data to a usable form for the well field management; (2) The geographical spread of the observation wells; (3) There was no electrical transmission provided to any observation well, thus requiring an alternative power source; (4) The surface temperature in the well field area varies from more than 50 C in the summer to a -4 C in the winter; and, (5) The depth to the water surface. Although the observation wells varied in depth from 300 m to 1,600 m, the piezometric surfaces fell within a range of depths from 108 m to 146 m affected by artesian pressures in four of the five wells. The system that was ultimately installed at each well included two shoe box-sized units, which were actually placed within the well casing and suspended 2 m below the ground surface. The system developed, monitors changes exceeding 15 m in fluid levels to a high degree of accuracy and repeatability along with the capability of easily resetting the sensor to a different depth if the range of levels changes. The power supply for this system is a 12 VAC gel-cell battery. The battery box contains a trickle charger regulating the flow of current from the solar photoelectric cell. The FM receiver not only receives the data signal but prepares the signal for the computer printer by formatting the data. The data received from each transmitter includes a four-digit data number for the depth of elevation, the code number of each transmitter, and the consistency code number. This FM telemetry system performed with a degree of sensitivity and reliability far better than expected. Field assembly and operation were proven to be uncomplicated. The range of potential uses run from monitoring liquid levels in storage tanks to checking tidal fluctuations among remote stretches of coastline to observing water levels in multiple wells during elaborate pumping tests. Any need for frequent monitoring of liquid levels at remote sites with difficult access. (Lantz-PTT)
W86-04218

FIELD TERMINAL FOR COLLECTION AND ANALYSIS OF GEOLOGICAL AND HYDROGEOLOGICAL DATA,
BAT Envitech, Inc., Long Beach, CA.
A. M. Petsonk.
Ground Water Monitoring Review, Vol. 6, No. 2, p 130-134, Spring 1986. 7 fig, 1 tab, 3 ref. Swedish Council for Building Research Project No. 840895-3 and NSBTD Project No. 83-5657.

Descriptors: *Field tests, *Data acquisition, *Data interpretation, *Computers, Geohydrology, Terminals, Hydraulic conductivity, Soil profiles, Soil porosity, Water networks, Case studies.

Having immediate, automated field access to data gathered during geological and hydrogeological investigations can be crucial to definition of the scope and direction of test procedures, as well as to the interpretability of results. A portable, briefcase-sized data collection and analysis instrument has therefore recently been developed, capable of operating as a stand-alone or operator-guided field unit. This terminal is pre-programmed for a number of standard applications. An operator's terminal and independent data collection microcontroller are the major components of this system. Data may be collected from any combination of four ports: an internal, programmable interval timer, a pulser (shaft encoder), and two 14-bit analog-to-digital (A/D) inputs. The latter are primarily used for pressure or resistance transducers. Reading of data may be triggered automatically by the timer and/or pulser, or be performed upon operator command. Many thousands of data points may be stored in the microcontroller, representing one or several tests of any type, intermixed. Via the operator's terminal, any subset of this stored data may be examined, erased, modified or analyzed. A 25-character LCD display and a four-color printer/plotter are used to record data and results of analyses. Data may also be transferred to an external computer for more extensive manipulation. Three examples of how this terminal may be used in the field in connection with site investigations are presented in this paper. They involve (a) measurement of saturated hydraulic conductivity, (b) determination of soil stratigraphy using pore pressure sounding, and (c) water network profiling. (Lantz-PTT)
W86-04221

MICRO COMPUTERS APPLIED TO GROUND WATER MONITORING AND TESTING,
Dames and Moore, Baldwinsville, NY.
For primary bibliographic entry see Field 2F.
W86-04222

SELECTING AND APPLYING MAGNETIC FLOWMETERING SYSTEMS,
Fischer and Porter, Co., Warminster, PA.
For primary bibliographic entry see Field 8C.
W86-04297

MONITORING CHANGES IN TOTAL AND UNFROZEN WATER CONTENT IN SEASONALLY FROZEN SOIL USING TIME DOMAIN REFLECTOMETRY AND NEUTRON MODERATION TECHNIQUES,
Department of Agriculture, Ottawa (Ontario).
For primary bibliographic entry see Field 2G.
W86-04305

PARAMETER ESTIMATION FOR A MODEL OF SPACE-TIME RAINFALL,
Interstate Commission on the Potomac River Basin, Rockville, MD.
For primary bibliographic entry see Field 2B.
W86-04321

NEW APPROACH FOR INSTANTANEOUS RAIN AREA DELINEATION IN THE MIDLATITUDES USING GOES DATA,
Atmospheric Environment Service, Downsview (Ontario).
For primary bibliographic entry see Field 2B.
W86-04325

IDENTIFYING HYDRAULICALLY CONDUCTIVE FRACTURES WITH A SLOW- VELOCITY BOREHOLE FLOWMETER,
Geological Survey, Denver, CO. Water Resources Div.
A. E. Hess.
Canadian Geotechnical Journal CGJOAH, Vol. 23, No. 1, p 69-78, February 1986. 15 fig 18 ref.

Descriptors: *Borehole flowmeter, *Heat-pulse flowmeter, *Borehole geophysics, *Flow measurement, Low flow, Tag-trace principle, Granitic rock, Manitoba, Canada.

The U.S. Geographical Survey used a recently developed heat-pulse flowmeter to measure very slow borehole axial water velocities in granite rock at a site near Lac du Bonnet, Manitoba, Canada. The flowmeter was used with other geophysical measurements to locate and identify hydraulically conducting fractures contributing to very slow vertical water flow in the two boreholes selected for study. The heat-pulse flowmeter has no moving parts and operates on a tag-trace principle. It is an improved version of the flowmeter developed by the Water Research Centre in England in 1975. The U.S. Geological Survey's heat-pulse flowmeter has a flow measuring range in water of 0.06-6 m/min, and can resolve velocity differences as slow as 0.01 m/min. This is an order of magnitude slower than the stall speed of spinner flowmeters. The flowmeter is 1.16 m long and 44 mm in diameter. It was calibrated in columns of 76 and 152 mm diameter, to correspond to the boreholes studied. The heat-pulse flowmeter system is evaluated and problems peculiar to the measurement of very slow axial water velocities in boreholes are discussed. (Author's Abstract)
W86-04337

IMPROVED ROTATING CYLINDER TECHNIQUE FOR QUANTITATIVE MEASUREMENTS OF THE SCOUR RESISTANCE OF CLAYS,
Ecole Polytechnique, Montreal (Quebec).
R. P. Chapuis, and T. Gatien.
Canadian Geotechnical Journal CGJOAH, Vol. 23, No. 1, p 83-87, February 1986. 4 fig, 16 ref.

Descriptors: *Clays, *Soil erosion, *Scour resistance, *Physical chemistry, Shear stress, River channels, Water quality, Measuring instruments, Erosion.

The methods developed to predict the action of eroding fluid on cohesive soils lead to contradictory positions. Most of them are questionable since they ignore the physicochemical parameters that seem to control the erosion process. In order to study the scour resistance of intact of remolded cohesive soils, a rotating cylinder technique allowing for the control of essential parameters was recently approved. Intact or remolded samples can be used. The water quality is controlled in order to respect the in situ physicochemical conditions. The shear stress transmitted by water to the clay surface is directly and accurately derived. The dry weight of eroded material per unit time and unit area, for given conditions, is also directly and adequately measured. The influence of water quality, or of any treatment of the clay, may be quantitatively analyzed. (Author's Abstract)
W86-04338

INSTRUMENTS AND METHODS. FIELD PH DETERMINATIONS IN GLACIAL MELT WATERS,
Manchester Univ. (England). Dept. of Geography.
R. C. Metcalf.
Journal of Glaciology JOGLAO, Vol. 30, No. 104, p 106-111, 1984. 5 fig.

Descriptors: *Laboratory equipment, *Melt waters, *Glaciers, *Hydrogen ion concentrations, Field tests, Sample preparation, Sample preservation.

Early glacial melt-water pH work was conducted in laboratories months after samples had been collected. Earlier work has shown that major solute changes can occur during such storage, and it has been suggested that summer melt waters can be greatly undersaturated with respect to atmospheric CO2, and that laboratory pH values can change significantly from in situ measurements for the same water sample. This study was undertaken to discover the cause of the cited discrepancies between laboratory and field measurements, and to develop a reliable field method for routine determination of pH in glacial melt waters, using commonly available equipment. A method is presented which enables field pH measurements that are reproducible within + or - 0.04 pH units to be made in glacial melt waters, using commonly available digital pH meters with combination electrodes. During initial spring snow melt in May 1981 at Gornergletscher. Switzerland, melt waters in the proglacial stream leaving the glacier terminus were oversaturated with respect to atmospheric p CO2, and rapidly increased pH during CO2 outgassing at in situ temperature and pressure. Summer ice melt from glaciers which are temperate in the ablation zone are usually undersaturated by about ten times with respect to atmospheric p CO2, and rapidly lower their pH values to achieve equilibrium upon encountering the atmosphere, as observed at Gornergletscher during July and August 1981. Gornergletscher summer proglacial stream waters, sometimes show pH increases from rock weathering, with the rate limited by the transfer rate of CO2 across the air-water interface to drive the weathering reactions. Throughout the year, any water parcel at equilibrium with atmospheric CO2 is generally at an equilibrium pH value, if filtration prohibits solute enrichment. For these reasons, laboratory pH measurements are unacceptable for quantitative studies of melt-water chemistry and should be discontinued. (Lantz-PTT)
W86-04355

SOIL WATER SAMPLERS IN ION BALANCE STUDIES ON ACIDIC FOREST SOILS,
Technical Univ. of Denmark, Lyngby. Lab. of Environmental Science and Ecology.
L. Rasmussen, P. Joergensen, and S. Kruse.
Bulletin of Environmental Contamination and Toxicology BECTA6, Vol. 36, No. 4, p 563-570, April 1986. 2 fig, 1 tab, 6 ref.

Descriptors: *Soil water, *Water sampling, *Lysimeters, *Acidic soils, *Soil water suction, *Aeration zone, Percolation, Field tests, Sorption.

Sorption characteristics of different types of soil water samplers (lysimeters) were examined under acidic soil conditions, both by installation in the field and by laboratory experiments, and a new method is introduced for current and constant soil water sampling under varying soil suctions in the unsaturated zone. As expected, during late spring and summer, increased mineralization resulted in increased elemental concentrations in the soil water; this was particularly apparent with percolation lysimeters. Although Al decreased during the summer with the porcelain cup lysimeter, other elements increased unexpectedly during summer (increases: Ca, 20%; Mg, 60%; Mn, 220%; Na, 30%; Ni, 30%; and Zn, 90%). Laboratory experiments established that by passage of the ceramic cup both soil leachates and blanks were enriched with considerable amounts of most applicable under all conditions. Percolation lysimeters also seem to work under all conditions. Although teflon disc lysimeters are not suited for soils with low clay content, they have the advantage of no important elemental adsorption enrichment of soil solutions, whereas the ceramic cup lysimeter should not be used at all in ion budget studies of acidic soils. (Rochester-PTT)
W86-04364

FLAVOR PROFILE ANALYSIS: TASTE AND ODOR CONTROL OF THE FUTURE,
Drexel Univ., Philadelphia, PA. Environmental Studies Inst.
For primary bibliographic entry see Field 5F.
W86-04370

CASE STUDY OF GEOSMIN IN PHILADELPHIA'S WATER,
Philadelphia Water Dept., PA.
For primary bibliographic entry see Field 5F.
W86-04371

CHEMISTRY AND PHYSIOLOGY OF ODOR SENSITIVITY,
Agricultural Research Service, Albany, CA. Western Regional Research Center
For primary bibliographic entry see Field 5F.
W86-04373

EARLY WARNING SYSTEM FOR TASTE AND ODOR CONTROL,
Southern California Metropolitan Water District, La Verne.
For primary bibliographic entry see Field 5F.
W86-04374

PERFORMANCE TESTS FOR THE MEASUREMENT OF PH WITH GLASS ELECTRODES IN LOW IONIC STRENGTH SOLUTIONS INCLUDING NATURAL WATERS,
Freshwater Biological Association, Ambleside (England).
W. Davison, and C. Woof.
Analytical Chemistry, Vol. 57, No. 13, p 2567-2570, November 1985. 3 tab, 20 ref.

Descriptors: *Measuring instruments, *Hydrogen ion concentration, *Glass electrodes, *Natural waters, Ion selective electrodes, Saline buffers, Electrodes, Acids.

Use of normal electrodes and established procedures for the measurement of the pH of low ionic strength freshwaters does not guarantee the accuracy. The prime source of error is associated with the liquid junction of the reference electrode. The performance of different commercial reference electrodes, used to measure pH of low ionic strength natural waters, has been tested against a renewable free diffusion junction. Comparative measurements on synthetic solutions were partially successful in predicting performance. Errors determined in dilute buffers, dilute acids, and distilled water were similar to those observed in natural waters, but the response in NBS buffers failed to reveal any problems. Poor electrodes depressed the pH from its true value, more so in stirred rather than quiescent solutions. The shift in pH upon stirring was largest for the worst electrodes in the most dilute solutions. Better electrodes were characterized by high flow rates of internal filling solution through the junction. As no one test could guarantee electrode performance, the adoption of a standard reference procedure to test electrodes was recommended. (Lantz-PTT)
W86-04451

GEOPHYSICAL TECHNIQUES TO DELINEATE SATURATED ALLUVIAL ZONES FOR THE SITING OF HVDC POWER TRANSMISSION RETURN ELECTRODES,
Ertec Western, Inc., Long Beach, CA.
For primary bibliographic entry see Field 2F.
W86-04471

INSTALLATION OF OBSERVATION WELLS ON HAZARDOUS WASTE SITES IN KANSAS USING A HOLLOW-STEM AUGER,
Geological Survey, Lawrence, KS. Water Resources Div.
C. A. Perry, and R. J. Hart.
Ground Water Monitoring Review GWMRDU, Vol. 5, No. 4, p 70-73, Fall 1985. 8.

Descriptors: *Observation wells, *Hazardous waste sites, *Hollow-stem auger, Groundwater protection, Groundwater pollution, Aquifers, Boreholes.

Twelve observation wells were installed at 3 hazardous waste sites in Kansas, using procedures to prevent contamination. Utmost care was taken to ensure that samples obtained from the wells were representative of the groundwater within the aquifer. This was accomplished by: (1) keeping the hollow-stem auger bit and flights clean, (2) clean-

ing the well casing and screen thoroughly before installation, (3) allowing only the formation of water to enter the hollow-stem auger, (4) preventing any surface material or borehole cuttings from falling into the well casing, and (5) allowing the saturated sand to collapse around the well screen and casing while withdrawing the auger. Because the use of water during well installation could contaminate the aquifer or dilute contaminants already present in the aquifer, two methods of well installation that did not introduce outside water to the borehole were used. The first method involved using a slotted 3/4-inch coupling that was attached to the bit plate of the hollow-stem auger, allowing formation water to enter the auger, thereby preventing sand-plug formation. This method proved to be adequate, except when drilling through clay layers, which tended to clog the slotted coupling. The second method involved screened well swab that allowed only formation water to enter the hollow-stem auger and prevented sand from plugging the hollow-stem auger when the bit plate was removed. (Lantz-PTT)
W86-04474

BIOLOGICAL ACCUMULATION AND MONITORING OF CHEMICAL WASTES IN ARCTIC WATERS,
Solway Marine Investigations, Maryport (England).
For primary bibliographic entry see Field 5B.
W86-04475

ANALYSIS OF WELL-AQUIFER RESPONSE TO A SLUG TEST,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-04541

USE OF ENHANCED LANDSAT IMAGERY FOR MAPPING LAKE DEPTH,
Winnipeg Univ. (Manitoba). Dept. of Geography.
S. Hathout.
Journal of Environmental Management JEVMA, Vol. 20, No. 3, p 253-261, April 1985. 4 fig, 2 tab, 10 ref.

Descriptors: *Satellite technology, *Mapping, *Lake morphology, Bathymetry, Remote sensing, Water depth, Vegetation, Clear Water Lake, Moose Lake, Cormorant Lake, Manitoba.

The image enhancement technique using a density slicer was applied in a preliminary investigation to map the water depth in three lakes in Northern Manitoba, namely Clear Water Lake, MooseLake and Cormorant Lake. Through the use of various combinations of color densities at a scale of 1:250,000 of Landsat imagery bands 5 and 7, it was possible to discriminate between various water depths from band 5 and to delineate shoreline, emergent vegetation and wind currents from band 7. The best interpretations of general color-enhanced images were obtained by a combination of 32 levels of color density and various combinations of gamma densities. Less than 32 level densities resulted in either fewer images or images with indistinct boundaries. The lake depths interpreted from the present study are very similar to those obtained from bathymetric maps of the three lakes. (Author's abstract)
W86-04603

DEDUCING THE MICROPHYSICAL CHARACTER OF PRECIPITATION FROM MULTIPLE-PARAMETER RADAR POLARIZATION MEASUREMENTS,
Applied Research Corp., Landover, MD.
For primary bibliographic entry see Field 2B.
W86-04625

AIRBORNE DOPPLER RADAR OBSERVATIONS OF A CONVECTIVE STORM,
National Severe Storms Lab., Norman, OK.
For primary bibliographic entry see Field 2B.
W86-04633

RETRIEVAL OF PRECIPITABLE WATER FROM BHASKARA-II MICROWAVE MEASUREMENTS AND ITS COMPARISON WITH NOAA-7 AND RADIOSONDE DATA,
Indian Space Research Organization, Ahmedabad. Space Applications Centre.
R. M. Gairola, B. S. Gohil, and P. C. Pandey.
Remote Sensing of the Environment RSEEA7, Vol. 18, No. 2, p 125-135, October 1985. 5 fig, 3 tab, 16 ref.

Descriptors: *Radiosonde, *Water vapor, *Microwaves, *Satellite technology, *Remote sensing, Bhaskara-II, NOAA-7, Cloud liquid water, Wind velocity, Mathematical analysis, Regression analysis, Statistical analysis.

The Satellite Microwave Radiometer (SAMIR-II) on board the second Indian remote sensing satellite, Bhaskara-II, measured microwave radiation at 19.35, 22.235, and 31.4 GHz. These measurements are primarily influenced by water vapor, cloud liquid water, and wind speed. The effect of collinearity among SAMIR-II channels has been examined to determine the effectiveness of a two- or three-channel subset for retrieving precipitable water (PW). The analysis indicated a decreasing correlation coefficient value from 0.87 to 0.65 with increasing frequency separation due to dynamical interdependence of meteorological variables on brightness temperature measurements. A correlation coefficient of 0.65 between two window channels, 19.35 and 31.4 GHz, is suggestive of using either of the two channels for water vapor retrieval. Performance of SAMIR-II channels has therefore been evaluated by retrieving (PW) using regression technique with all the three channels of SAMIR-II and its subset of the two channels, 19.35/22.235 and 22.235/31.4 GHz and comparing the results from NOAA-7 supplied PW and limited radiosonde derived PW. Comparison of PW derived from the regression models and NOAA-7 gave an rms difference of 0.7 to 1.0 g/sq cm. Retrievals of PW using 19.35 and 22.235 GHz channels and its comparison with near concurrent coastal radiosonde observations gave an rms difference of 0.32 gsq cm, comparable to the accuracy (0.2-0.4 g/sq cm) obtained from previous satellite-borne microwave radiometers. (Author's abstract)
W86-04653

PRACTICAL APPLICATION OF THEORETICAL MODELS TO MAGNETOMETER SURVEYS ON HAZARDOUS WASTE DISPOSAL SITES - A CASE HISTORY,
Illinois State Geological Survey Div., Champaign.
For primary bibliographic entry see Field 5E.
W86-04654

INTERPRETATION OF VLF RESISTIVITY DATA FOR GROUND WATER CONTAMINATION SURVEYS,
University of South Florida, Tampa. Dept. of Geology.
For primary bibliographic entry see Field 5B.
W86-04656

METHOD FOR SIMULTANEOUS IN SITU MEASUREMENT IN THE VADOSE ZONE OF FIELD-SATURATED HYDRAULIC CONDUCTIVITY, SORPTIVITY AND THE CONDUCTIVITY-PRESSURE HEAD RELATIONSHIP,
Guelph Univ. (Ontario). Dept. of Land Resource Science.
For primary bibliographic entry see Field 5B.
W86-04659

COMPARISON OF GAUZE SWABS AND MEMBRANE FILTERS FOR ISOLATION OF CAMPYLOBACTER SPP. FROM SURFACE WATER,
Nutrition Inst., Cairo (Egypt).
For primary bibliographic entry see Field 5A.
W86-04666

7C. Evaluation, Processing and Publication

INTERNATIONAL WATER STATISTICS - SOME CONCLUSIONS,
Wasserwerke Wien (Austria).
P. Suchomel.
Aqua AQUAAA, No. 1, p 14-18, 1986. 9 fig.

Descriptors: *Water Statistics, *Data interpretation, *Water use, *Available water, *Competing use, Spain, Italy, France, Norway, Industrial water, Domestic water, Statistical analysis, Information exchange.

The International Water Statistic Commission was formed in 1968 in order to compile comparable data of water supplies on an international level. After the definition of terms and the coordination of the manner of enquiries, a first ten-year report, 1968-1977, was published. The complete data of 10 countries of Western Europe is on hand. Only the available documentation from Spain, Italy, France and Norway is insufficient for a common presentation. By means of diagrams the development of the population, the water availability, the consumption and the types of water as well as the specific consumption figures, absolute and relative, are shown. A strong convergence of the various index numbers appears, whereby the high values stagnate and the low ones increase - the extreme values move closer together. The industrial consumption was strongly retrogressive in favor of the domestic consumption. The development of both tends into opposite directions. Besides these statistical observations, suggestions are made to complement the statistics in future by additional data. The creation of new statistical documentation brings better information, and opens doors to new problems areas. (Author's abstract)
W86-04150

PROGRAM TO CALCULATE AQUIFER TRANSMISSIVITY FROM SPECIFIC-CAPACITY DATA FOR PROGRAMMABLE CALCULATORS,
Geological Survey, Denver, CO. Nuclear Hydrology Program.
J. B. Czarnecki, and R. W. Craig.
Groundwater GRWAAP, Vol. 23, No. 5, p 667-672, September-October 1985. 2 fig, 6 tab, 6 ref.

Descriptors: *Computer Programs, *Aquifer Characteristics, *Transmissivity, Well Capacity, Storage Coefficient.

A program that will calculate aquifer transmissivity from the specific capacity of a well was developed for handheld programmable calculators. The program extends previous approaches which used the visual graphical interpolation of transmissivity values from type curves and solves directly a nonlinear equation for transmissivity, using a modified Regula Falsi solution algorithm. The program eliminates errors associated with visual interpolation of transmissivities obtained from type curves, especially for values of small transmissivities, and provides a quick and portable method of obtaining transmissivity values onsite. Results obtained with this technique are in good agreement with previously published results for both confined and unconfined aquifer-transmissivity determinations. (Author's abstract)
W86-04243

PERCENTILE ESTIMATION PROCEDURES FOR WATER QUALITY MANAGEMENT,
Water Research Centre, Swindon (England). Swindon Engineering Centre.
R. W. Crabtree, I. D. Cluckie, and C. F. Forster.
Effluent and Water Treatment Journal, Vol. 26, No. 2, p 46-50, February 1986. 3 fig, 4 tab, 16 ref. Serc Gr/B/87870.

Descriptors: *Probability distribution, *Effluent discharge data, *Parametric techniques, *Nonparametric techniques, Statistics, England, Water quality data, Rivers, United Kingdom, Percentile estimates.

Mathematical probability distribution fitting techniques were applied to 334 water quality data sets from a variety of rivers and effluent discharge in England. The results indicated that the 'best' estimate of the 95th percentile from a data set should be based upon probability distribution fitting. The three parametric distributions selected (normal, lognormal, and Pearson type 3) could only be fitted to half the data sets. The conclusion from this study is that each data set should be taken as being unique and should be analyzed individually with automatically using a particular technique or assuming a particular distribution. The estimate of the 95th percentile should be based on either the fitting of an appropriate parametric distribution or, if this is impossible, a non-parametric estimate should be used. It is invalid to make any assumptions about the distribution of any particular variable or sample type. The results of this study suggest that the two most commonly used methods used in the United Kingdom for water quality percentile estimation may not result in the best estimates of the 95th percentiles. (Rochester-PTT)
W86-04340

DIGITAL DISTRIBUTION SYSTEM RECORDS: A JOINT VENTURE,
North Surrey Water Co., Staines (England).
E. G. Moss, and R. H. Morgan.
Institution of Water Engineers and Scientists Journal JIWSDI, Vol 40, No. 1, p 59-69, February 1986. 4 fig, 2 ref.

Descriptors: *Management planning, *Pipelines, *Digital computers, *Maps, *Networks, *Utilities, *Data storage and retrieval, England, Costs.

The digital records system developed jointly by Rickmansworth Water Company, North Surrey Water Company, and Inspectorate E.A.E., Ltd. (all in England) is described. Development, commissioning, digitizing procedures, applications, and costs and benefits of the system are described. Hardware in each system includes a Prime 2250 computer, with from 0.5 to 1.5 megabyte core and 68 megabyte or 226 megabyte hard disc storage, a digitizing work station, with a high resolution graphics terminal with light pen and detachable keyboard and a A0 sized digitizer, a video display unit, dot matrix printer and an A3 flat bed plotter and an A0 drum plotter. In addition to providing plans in various scales, this system was adapted to network analysis, and various types of information can be recorded, such as 'burst mains' incidents. The digital records appraoch involved an estimated initial capital cost of 70,000 British pounds, with maintenance of equipment costing 5,500 pounds per annum. The initial cost of digitizing the existing records was estimated at 30,000 pounds. (Rochester-PTT)
W86-04380

METHODS FOR VALIDATION OF PRECIPITATION PH: APPLICATIONS TO TEXAS DATA,
Texas Univ. at Austin. Environmental and Water Resources Engineering Group.
For primary bibliographic entry see Field 5A.
W86-04389

EMPIRICAL EQUATIONS OF GROUNDWATER RECHARGE PATTERNS,
Ife Univ. (Nigeria). Dept. of Geography.
For primary bibliographic entry see Field 2F.
W86-04390

OPERATIONAL TESTING OF HYDROLOGICAL SIMULATION MODELS,
National Hydrology Research Inst., Ottawa (Ontario).
V. Klemes.
Hydrological Sciences – Journal – des Sciences Hydrologiques HSJODN, Vol. 31, No. 1, p 13-24, March 1986. 1 fig, 10 ref.

Descriptors: *Testing procedures, *Hydrologic models, *Land use, *Simulation, *Climate, Geography, Mathematical models, Environmental changes.

A hierarchical scheme for the systematic testing of hydrological simulation models is proposed that ties the nature of the test to the difficulty of the model task. The testing is referred to as operational, since its merely to assess the performance of a model in situations as close as possible to those in which it is supposed to be used as practice; in other words, to assess its operational adequacy. The measure of the quality of performance is the degree of agreement between the simulation results and observations. Hence, the power of the tests being proposed is rather modest, and even a fully successful result can be seen only as a necessary, rather than a sufficient, condition for model adequacy vis-a-vis the specific modeling objective. The scheme contains no new or original ideas; it is merely an attempt to present an organized methodology based on standard techniques. Its main aim is to accomodate the possibility of testing model transposability, both of the simple geographical kind and of more complex kinds, such as transposability between different types of land use, climate, and other types of environmental changes. (Author's Abstract)
W86-04391

SYSTEMATIC APPROACH FOR EVALUATING THE QUALITY OF GROUND WATER MONITORING DATA,
Kennedy/Jenks Engineers, San Francisco, CA.
For primary bibliographic entry see Field 5G.
W86-04472

PROCESS CONTROL AND DATA ACQUISITION COMPUTERS IN THE WATER INDUSTRY,
Brown Boveri Kent (East Africa) Pty Ltd., Singapore.
For primary bibliographic entry see Field 5G.
W86-04519

FOURIER INFERENCE: SOME METHODS FOR THE ANALYSIS OF ARRAY AND NON-GAUSSIAN SERIES DATA,
California Univ., Berkeley. Dept. of Statistics.
D. R. Brillinger.
Water Resources Bulletin WARBAQ, Vol. 21, No. 5, p 743-756, October 1985. 13 fig, 2 tab, 44 ref. NSF DMS-8316634.

Descriptors: *Fourier analysis, *Network data, *Cloud physics, *Storms, *Statistical analysis, *Runoff rates, Sonar, Mississippi River, Time series analysis, Nonlinear regression, Finite element, Method, Mathematical models, Regression analysis, Data interpretation.

Basic notations, definitions, and statistical properties of the Fourier transforms of (large) segments of stationary processes are set forth and it is shown how these properties may be employed to build analyses and to suggest techniques for making statistical inferences. To illustrate the approach, procedures are developed for the following: (1) estimating cloud and storm motion, (2) passive sonar, and (3) fitting a model for river runoff by making use of both the power spectrum and bispectrum. The last of these cases is illustrated with a preliminary analysis of monthly observations of Mississippi River runoff data. The processes to which the techniques discussed may be applied include time functions, space functions, or spatial-temporal functions (or even point processes). The statistics computed may be linear, quadratic, cubic, or more complicated. The situation may be modeled via a dimensional parameter or not. (Rochester-PTT)
W86-04530

PARAMETRIC/NONPARAMETRIC MIXTURE DENSITY ESTIMATION WITH APPLICATION TO FLOOD-FREQUENCY ANALYSIS,
Texas Univ. at El Paso. Dept. of Mathematics.
For primary bibliographic entry see Field 2E.
W86-04531

BAYESIAN MODELS OF FORECASTED TIME SERIES,
Virginia Univ., Charlottesville. Dept. of Systems Engineering.
For primary bibliographic entry see Field 2A.
W86-04532

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: I. REVIEW, ALGORITHM, AND SIMULATION EXPERIMENTS,
Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 2E.
W86-04533

KALMAN FILTER ESTIMATION AND PREDICTION OF DAILY STREAM FLOWS: II APPLICATION TO THE POTOMAC RIVER,
Halff (Albert H.) Associates, Inc., Dallas, TX.
For primary bibliographic entry see Field 2E.
W86-04534

ANALYSIS OF WATER QUALITY INDICES,
Institut National de la Recherche Scientifique, Sainte-Foy (Quebec).
For primary bibliographic entry see Field 5G.
W86-04598

COMPUTER DATA BASE FOR OVERVIEW OF GROUND WATER POLLUTION INVESTIGATIONS,
New Jersey Dept. of Environmental Protection, Trenton. Div. of Water Resources.
J. L. Hoffman.
Ground Water Monitoring Review GWMRDU, Vol. 6, No. 1, p 76-79, Winter 1986. 5 fig, 4 ref.

Descriptors: *Data storage and retrieval, *Groundwater pollution, *Groundwater management, Data collections, Computers, New Jersey, Input-output analysis.

A vast amount of managerial information is needed to efficiently conduct and monitor concurrent investigations of groundwater pollution sites. The New Jersey Geological Survey has developed a computer data base to summarize these data and provide a template for their systematic collection. A series of computer programs access the data base and produce a variety of reports, such as: ABCSORT (case by site), PINDEX (computer data base data), INITSORT (computer database active cases), GWPSORT (shortened data display for active sites), CNTYSORT (active cases by county), QUADSORT (all cases by quadsheet), STATSORT (all sites by status; a shortened version of the data base), and, SUMMARY (summary of all data). These reports greatly simplify the review of groundwater pollution case loads, geographical distribution and allocation of resources. The accuracy and usefulness of the reports are directly related to the timeliness of the information in the data base. Descriptions of the input data and the output reports show the utility of this method for information storage and retrieval. These programs could easily be adapted to other situations requiring similar types of data. Copies of the programs are available from the author. (Lantz-PTT)
W86-04657

8. ENGINEERING WORKS

8A. Structures

RISK COSTS FOR NEW DAMS: ECONOMIC ANALYSIS AND EFFECTS OF MONITORING,
Stanford Univ., CA. Dept. of Industrial Engineering.
For primary bibliographic entry see Field 6C.
W86-04156

DESIGN AND CONSTRUCTION OF NEW SPILLWAYS AND OTHER REMEDIAL WORKS TO THE LITTON RESERVOIRS, NEAR BRISTOL,
Watson Hawksley, London (England).
M. C. Bailey.
Intitution of Water Engineers and Scientists Jour-

nal JIWSDI, Vol. 40, No. 1, p 37-53, February 1986. 9 fig, 1 tab, 6 ref.

Descriptors: *Design standards, *Dam construction, *Spillways, *Litton Reservoir, *Bristol, England, Dams, Reservoirs, Slope protection, Hydraulic engineering, Engineering, Fisheries, Silt.

The design and construction are described of various remedial works needed at the Upper and Lower Litton reservoirs, near Bristol, England. These improvements to the two 130-yr-old facilities have added very many years of further service. Includeed are: a brief history of the reservoirs, a summary of inspecting engineer's reports, hydrological and hydraulic studies a summary of consulting engineer's report on recommended work, description of the design of the remedial works for the lower dam (increasing spillway size and stilling basin), upper dam (increasing size of spillway and bywash channel), upstream slope protection, upper dam core protection, refurbishment of scour and draw-off arrangements at the two dams, work on recirculation facility for fish rearing, silt removal from the reservoirs and repairs to masonry retaining walls supporting the upstream and downstream toes. (Peters-PTT)
W86-04379

CHICAGO AREA'S TUNNEL AND RESERVOIR PLAN,
Metropolitan Sanitary District of Greater Chicago, IL.
For primary bibliographic entry see Field 5G.
W86-04498

8B. Hydraulics

FLOW RECIRCULATION IN CENTRIFUGAL PUMPS,
McGraw-Edison Co., Harrison, NJ. Worthington Div.
W. H. Fraser.
Water Engineering and Management, Vol. 132, No. 8, p R14-R17, July 1985. 5 fig.

Descriptors: *Pump testing, *Hydraulic design, *Recirculated water, *Impellers, Hydraulic machinery, Hydraulic equipment, Cost analysis, Mathematical studies.

When flows less than that of peak efficiency occur in a centrifugal pump impeller, the pressure field becomes increasingly distorted until at some point the pressure gradient reverses and a localized reversal of the flow takes place. This is the point of recirculation, which can occur at the discharge or the suction of the impeller, or at both of these points. Suction recirculation can cause surging and cavitation at the inlet vanes of the impeller. Similarly, extensive damage to the pressure side of the impeller vane at the discharge has been observed in many pumps operating at reduced flow rates. The hydraulics of suction and discharge recirculation are described along with methods of predicting recirculation. The recommended minimum flow to prevent recirculation in actual operation will depend upon the size of the pump, as well as the fluid pumped. Analyses of suction recirculation have shown that the higher design suction specific speed, the closer will be the point of suction recirculation to the rated capacity. Similarly, the closer discharge recirculation capacity is to the rated capacity, the higher will be the efficiency. Both the designer and user of centrifugal pumps should know the flow rates at which suction and discharge recirculation occur. (Geiger-PTT)
W86-04294

OPTIMAL DISCHARGE PROFILES FOR SUDDEN CONTAMINANT RELEASES IN STEADY UNIFORM OPEN-CHANNEL FLOW,
For primary bibliographic entry see Field 5E.
W86-04344

INLET DESIGN FOR RECTANGULAR SETTLING TANKS BY PHYSICAL MODELING,
Washington State Univ., Pullman. Dept. of Civil and Environmental Engineering.
L. Y. Yee, and A. F. Babb.
Water Pollution Control Federation Journal JWPFA, Vol. 57, No. 12, p 1168-1177, December 1985. 9 fig, 3 tab, 58 ref.

Descriptors: *Sedimentation basins, *Hydraulic engineering, *Flow characteristics, Model tests, Fluid density, Wastewater facilities, Sanitary engineering.

This research was intended to develop an understanding of the hydraulics of right angle approach channels and to present suggestions for design that will furnish relatively uniform flow at the upstream end of a rectangular wastewater sedimentation tank. Because of the effect of density currents on the overall tank flow patterns, including those as the entrance, the theory of variable density flow is discussed. The design principles are illustrated by model tests with both homogeneous and variable density fluids. Although symmetrical approach flow should be used when possible, an asymmetrical inlet configuration can be made to perform reasonably well with careful design. Poorly designed inlet designs often are not detected until a plant is operating at higher capacities. The prime causes for skewed distributions are uneven flow distributions in the inlet trough and deflection by the baffle in the inlet zone. Three methods used to achieve a more uniform flow across the tank width are: (1) create a higher head loss in the inlet ports relative to that in the trough if breaking up of flocs is not a concern; (2) relocate the inlet ports away from the tank sides; and (3) add partitions in the inlet zone to reduce the baffle deflection effect. Heavier density currents tend to stabilize flow patterns and are important in generating uniform velocity across the tank width. (Rochester-PTT)
W86-04505

ANALYSIS OF WELL-AQUIFER RESPONSE TO A SLUG TEST,
Princeton Univ., NJ. Dept. of Civil Engineering.
For primary bibliographic entry see Field 2F.
W86-04541

HYDRODYNAMIC PRESSURE ON A DAM DURING EARTHQUAKES,
Indian Inst. of Science, Bangalore. Dept. of Applied Mathmatics.
A. Chakrabarti, and V. N. Nalini.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 111, No. 12, p 1435-1439, December 1985. 1 fig, 3 ref.

Descriptors: *Dams, Earthquakes, *Mathematical studies, *Hydrodynamics, *Fourier analysis, Water pressure, Theoretical analysis, Mathematical equations, Dam stability.

A straightforward analysis involving Fourier cosiune transforms and the theory of Fourier series is presented for the approximate calculation of the hydrodynamic pressure exerted on the vertical upstream face of a dam due to constant earthquake ground acceleration. The analysis uses the 'Parseval relation' on the Fourier coefficients of square integrable functions, and directly brings out the mathematical nature of the approximate theory involved. (Author's abstract)
W86-04621

FINITE ELEMENT MODELING OF INFINITE RESERVOIRS,
Laurentian Univ., Sudbury (Ontario). Dept. of Civil Engineering.
S. K. Sharan.
Journal of Engineering Mechanics (ASCE) JENMDT, Vol. 111, No. 12, p 1457-1469, December 1985. 8 fig, 20 ref, 2 append.

Descriptors: *Dams, *Reservoirs, *Finite element method, *Mathematical studies, Numerical analysis, Mathematical models, Model studies, Hydrodynamics, Boundary conditions.

A technique is developed to model the effects of radiation damping in the finite element analysis of hydrodynamic pressures on dams subjected to a harmonic horizontal ground motion. The water in the reservoir is treated as being compressible; however, its vibration is assumed to be two-dimensional and of small amplitude. In finite element modeling, an infinite reservoir must be truncated at a finite distance from the dam, and a suitable boundary condition must be imposed at the truncation surface. Sommerfeld or similar existing boundary conditions are found to be satisfactory for excitation frequencies greater than the fundamental frequency of the reservoir. However, for lower frequencies, which are of greater importance in the seismic response analysis of dams, such boundary conditions require a very large extent of the reservoir to be considered in the analysis. The principal merit of the proposed boundary condition is that the reservoir may be truncated at a very short distance from the dam, resulting in great computational advantages. The effectiveness of the proposed method is demonstrated by analyzing several cases. (Author's abstract)
W86-04622

8C. Hydraulic Machinery

MOTOR CONTROL ELIMINATES ERRATIC DISTRIBUTION PRESSURE,
El Reno City Public Works, OK.
For primary bibliographic entry see Field 5F.
W86-04296

SELECTING AND APPLYING MAGNETIC FLOWMETERING SYSTEMS,
Fischer and Porter, Co., Warminster, PA.
M. F. Griffin.
Water Engineering and Management, Vol. 132, No. 12, p 33-36, November 1985. 2 fig, 1 tab.

Descriptors: *Flowmeters, *Comparison studies, Hydraulic equipment, Cost analysis, Flow measurement, Measuring instruments, Electrodes.

A magnetic flowmetering system consists of a flowtube installed in the process pipeline and a transmitter mounted on the flowtube or in a remote location. An understanding of both a-c and pulsed d-c systems is important in selecting and applying magnetic flowmetering equipment. Applied to a conventional magnetic flow-meter, the moving conductor or fluid passes through a magnetic field in the flowtube where a pair of electrodes picks up the induced voltage. Conventional flowtubes may be metallic (and lined with an insulated material) or nonmetallic. In most water and wastewater applications, AISI Type 316 stainless steel electrodes are used. A special, conical-shaped electrode, which protrudes into the process stream for self-cleaning, is especially desirable on sludge flows. Conventional a-c systems provide the broadest application possibilities, but pulsed d-c systems provide high accuracy, wide range capability, and automatic zeroing for the measurement of homogeneous processes. This latter feature and the ability to handle both the signal cable and power leads on the same conduit or cable tray make the d-c systems more economical than the a-c flowmeter systems. (Geiger-PTT)
W86-04297

MDS PROJECT - MAIN DIMENSIONS AND ECONOMICS,
Tahal Consulting Engineers Ltd., Tel-Aviv (Israel).
Z. Shalev.
Journal of Energy Engineering (ASCE) JLEED9, Vol. 111, No. 1, p 74-88, September 1985. 6 fig, 4 tab.

Descriptors: *Tunnels, *Hydroelectric plants, *Economic aspects, *Conveyance structures, *Feasibility studies, Project planning, Pumping plants, Conduits, Pipelines, Design criteria, Water conveyance, Israel.

The conveyance capacity of the tunnel designed to move water from the Mediterranean Sea to a power station on the Dead Sea was calculated to refill the Dead Sea to its historic level at rate

which maximizes the project's net benefits. The generation capacity of the project was calculated to make optimal use of the amounts of water thus conveyed. In calculating the dimensions of these two main components of the scheme, as well as those of other facilities, the long-term economic impact of the project on the entire Israeli national power system was evaluated. These studies formed part of the feasibility study which proceeded in parallel with outline design of the facilities. Both engineering and economic studies have adopted a rather conservative approach and included numerous iterations and sensitivity tests. The feasibility study concludes with a recommendation to implement the scheme on the grounds of direct quantifiable benefits only, even though there are several other benefits to the power system, and to the national economy in general. (Author's abstract)
W86-04637

8D. Soil Mechanics

IMPROVED ROTATING CYLINDER TECHNIQUE FOR QUANTITATIVE MEASUREMENTS OF THE SCOUR RESISTANCE OF CLAYS,
Ecole Polytechnique, Montreal (Quebec).
For primary bibliographic entry see Field 7B.
W86-04338

8E. Rock Mechanics and Geology

CLOSED-SYSTEM FREEZING OF SOIL IN EARTH DAMS AND CANALS,
Bureau of Reclamation, Denver, CO. Div. of Research and Lab. Services.
C. W. Jones.
Canadian Geotechnical Journal CGJOAH, Vol. 23, No. 1, p 1-8, February 1986. 10 fig, 12 ref.

Descriptors: *Dam stability, *Freezing, *Dam designs, *Earth dams, *Canals, *Soil density, Soil water, Soil shrinkage, Soil tests, Teton Dam, Idaho, Snow, Cold regions.

Field and associated laboratory experiments with closed-system freezing in earth embankment dams and canals are presented. This type of freezing can cause a redistribution of soil density and moisture, which needs to be considered in the design of soil structures used as water barriers in cold regions. Frost-depth measurements are made during the winter of 1978-1979 on two earth dams during interruption of their construction, and on the Teton Dam remnant in Idaho, are shown, along with associated soil conditions, air freezing indexes, and insulating effects of snow and, for one dam, a loose soil cover. Some trends of density and moisture changes near the embankment surfaces where established. Keeping in mind the known affects of freezing on soils, the paper raises questions about possible changes in soil density and shrinkage of embankments in contact with rock abutments that might adversely affect the safety of earth dams. (Author's Abstract)
W86-04336

8G. Materials

TRY TACKLING A CORROSION INVESTIGATION,
Los Angeles City Dept. of Water and Power, CA.
D. W. Heumann.
Water Engineering and Management WENMD2, Vol. 132, No. 11, p 32-34, October 1985. 4 fig, 4 ref.

Descriptors: *Water distribution, *Pipes, *Corrosion control, Corrosion, Utilities, Monitoring, Data storage and retrieval, Pipelines.

There are a number of preliminary steps that should be taken by water utility departments before consulting outside firms to aid in handling problems of water main corrosion. The Los Angeles Department of Water and Power (LADWP) has established a material recovery program which tags sections of removed corroded pipe before it is sold for scrap. Field crews are instructed to photograph and label tagged sections and the photographs are organized by location and date to give a realistic and permanent record of system conditions. The LADWP also maintains records of consumer complaints of 'red water' by address of the complainant, service zone, and problem description in computer storage. Celerity tests are made regularly in the LADWP and a special form is used by the department to maintain records of repaired pipe leaks to help locate where corrosion was producing the main leaks. Iron analysis are performed routinely on all water sources feeding Los Angeles. The prevailing flow directions in the distribution network must be established to detect sources of corrosion. The corrosion detection methods used by the LADWP are not beyond the means of smaller water utilities. (Geiger-PTT)
W86-04619

8I. Fisheries Engineering

ASSESSING POPULATION EFFECTS FROM ENTRAINMENT OF FISH AT A LARGE VOLUME WATER INTAKE,
Battelle Pacific Northwest Labs., Richland, WA.
R. H. Gray, T. L. Page, D. A. Neitzel, and D. D. Dauble.
Journal of Environmental Science and Health JESEDU, Vol. A21, No. 2, p 191-209, 1986. 4 fig, 5 tab, 14 ref.

Descriptors: *Water intake, *Power plants, *Entrainment, *Salmon, *Columbia River, *Seasonal variation, Rainbow trout, Fish populations.

A method is described for estimating the entrainment of juvenile chinook salmon (Oncorhynchus tshawytscha) at the intake of Washington Public Power's Hanford Generating Project on the Columbia River. The method involved sampling fish in the river and entrained fish (both marked recaptures and naturally-occurring downstream migrants) within the intake. and estimating (1) the total number of fish entrained, (2) the size of the natural population, and (3) the percentage of the natural population affected. Rainbow trout (Salmo gairdneri) juveniles were used in the mark-recapture studies, whereas natural populations of chinook salmon were sampled within the intake during the annual downstream migration. Young-of-the-year chinook salmon are not susceptible to impingement or entrainment until they become free swimming and pass the intake. Impingement and entrainment generally involved fry ranging in size from 3.3-5.5 cm fork length. Peak impingement and entrainment of chinook salmon fry occurred before maximum catches in seine hauls, suggesting that the intake is a more efficient sampler of smaller fish. As average fish size increased during early June in seine samples, chinook salmon impingement and entrainment fell to near zero. (Rochester-PTT)
W86-04383

10. SCIENTIFIC AND TECHNICAL INFORMATION

10C. Secondary Publication And Distribution

SECOND INTERNATIONAL CONFERENCE ON GROUND WATER QUALITY RESEARCH: PROCEEDINGS.
Oklahoma State Univ., Stillwater. Univ. Center for Water Research.
For primary bibliographic entry see Field 2F.
W86-04042

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